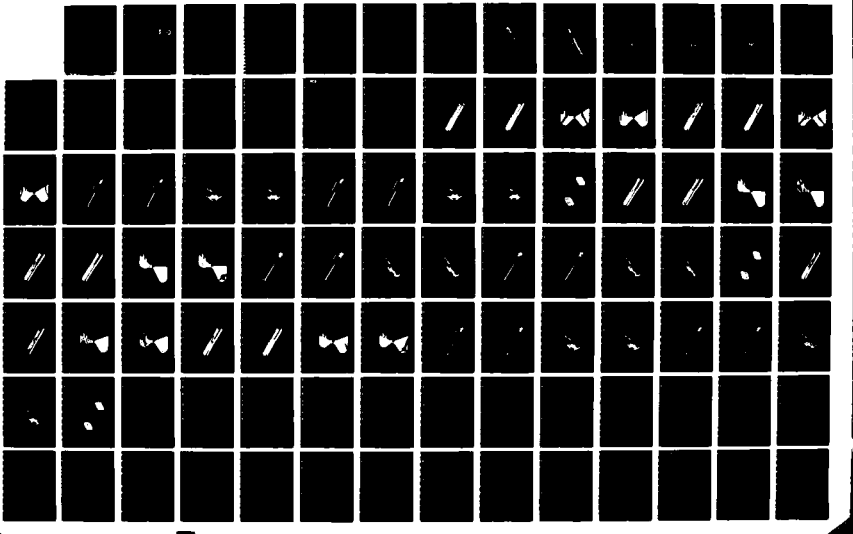
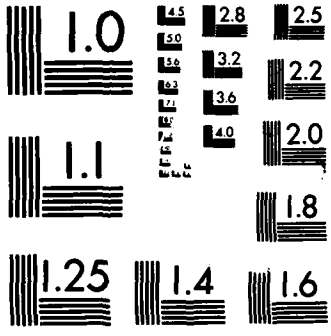
AD-A183 991 LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN NORTHERN ORDNANCE DIV R RATHE ET AL APR 87 1/5

UNCLASSIFIED FMC-E-3041-VOL-D2-PT-3 DAAA21-86-C-0047 F/G 19/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

DTIC FILE COPY

Lightweight Towed Howitzer Demonstrator

Final Report

Volume D2 - Part III

Structural Analysis of Cradle

April 1987

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SEP 03 1987
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AD-A183 991

Contract Number DAAA21-86-C-0047

FMC CORPORATION
Northern Ordnance Division
4800 East River Road
Minneapolis, Minnesota 55421

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* 155mm towed gun howitzer, advanced weapons, composite cradle, composite hydraulic actuators, composite trails, field artillery weapon, firing stability analysis, howitzers, hydraulic control valves with force feedback, hydraulic joystick control of gun direction, hydraulic inertial rammer, hydraulic opening breech, hydraulic primer autoloader, ~~lightweight towed howitzer demonstrator (LTHD)~~, load out of battery howitzer, mortar howitzer, recoil energy recovery, recoil mechanism ~~using~~ metal matrix composites, titanium muzzle brake, titanium platform, titanium spade, titanium walking beams, thermal stability, towing stability analysis, unconventional weapons, ~~and weight reduction of artillery~~

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The LTHD (Lightweight Towed Howitzer Demonstrator) was to be a 9,000 lb equivalent to the M198, transportable via Blackhawk helicopter, with reduced emplacement time using fewer personnel. The FMC design achieved weight reduction via a mortar-like configuration, composites structure, and hydraulic actuators. Recovery of power from the recoil system, in turn, facilitated crew reduction via hydraulic emplacement, four-way joystick tube lay, and power ramming. FMC completed Concept Development (Ph I) and two-thirds of Detailed Design (Ph II) prior to funds running out. Keywords:

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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	D2/100	Structural Analysis of Cradle
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	D2/130	o January 22 run - Computer Results
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	D2/370	CEL Memo: December 8, 1986
	D2/380	CEL Memo: December 16, 1986
	D2/390	Torque Program

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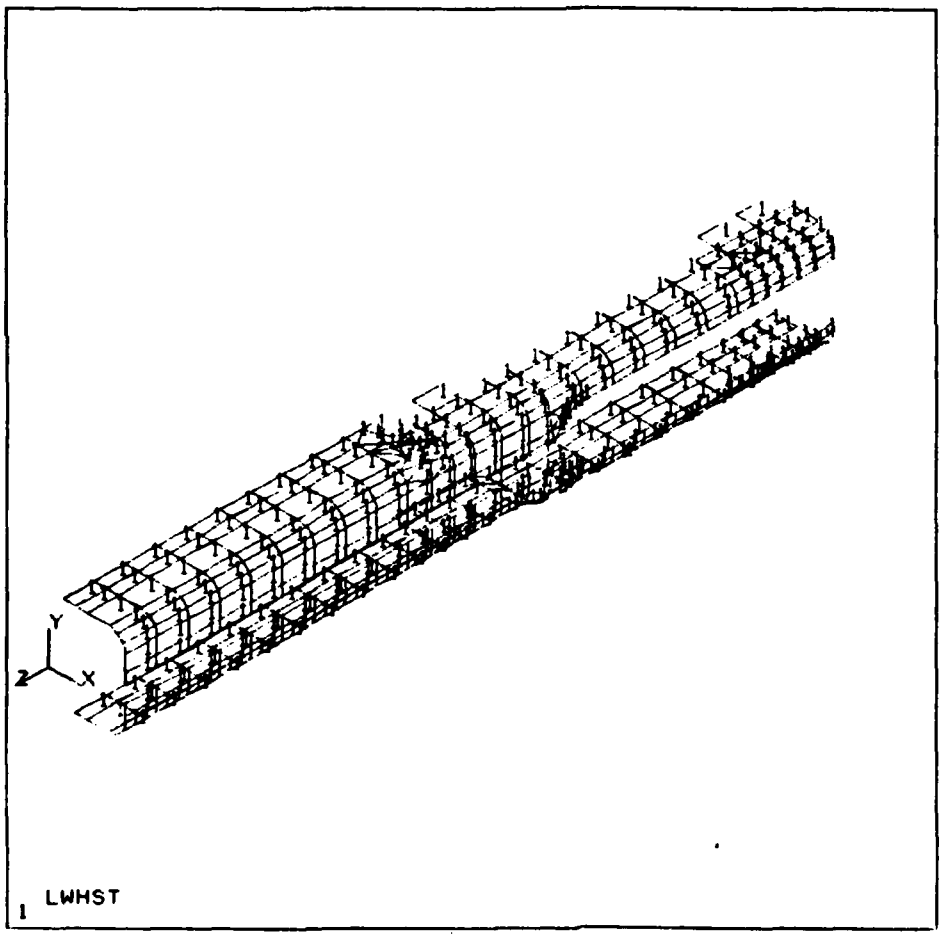
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1 | 23

GEOMETRY PLOTS - MODEL 11



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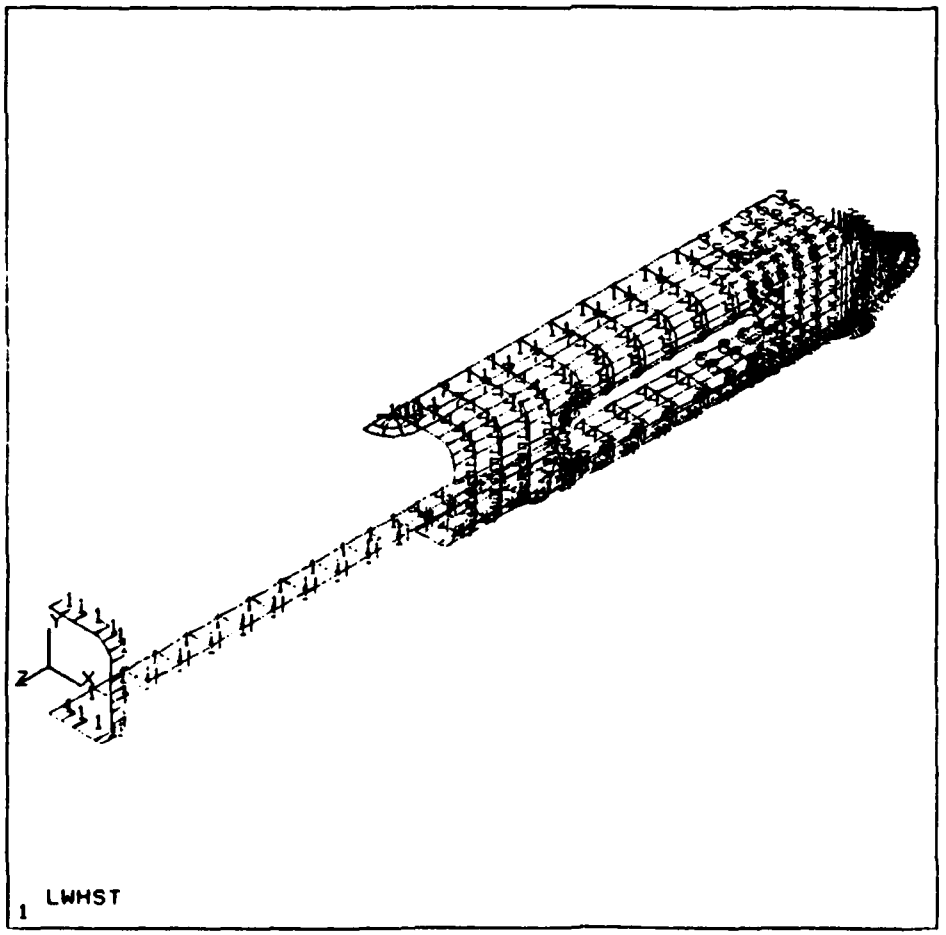
FEB 6 1987
8:52:46
PLOT NO. 1
PREP7 ELEMENTS
TNUM=1

XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115

Model 11



ANSYS 4.2B
FEB 6 198[illegible]
8:53:31
PLOT NO. 2
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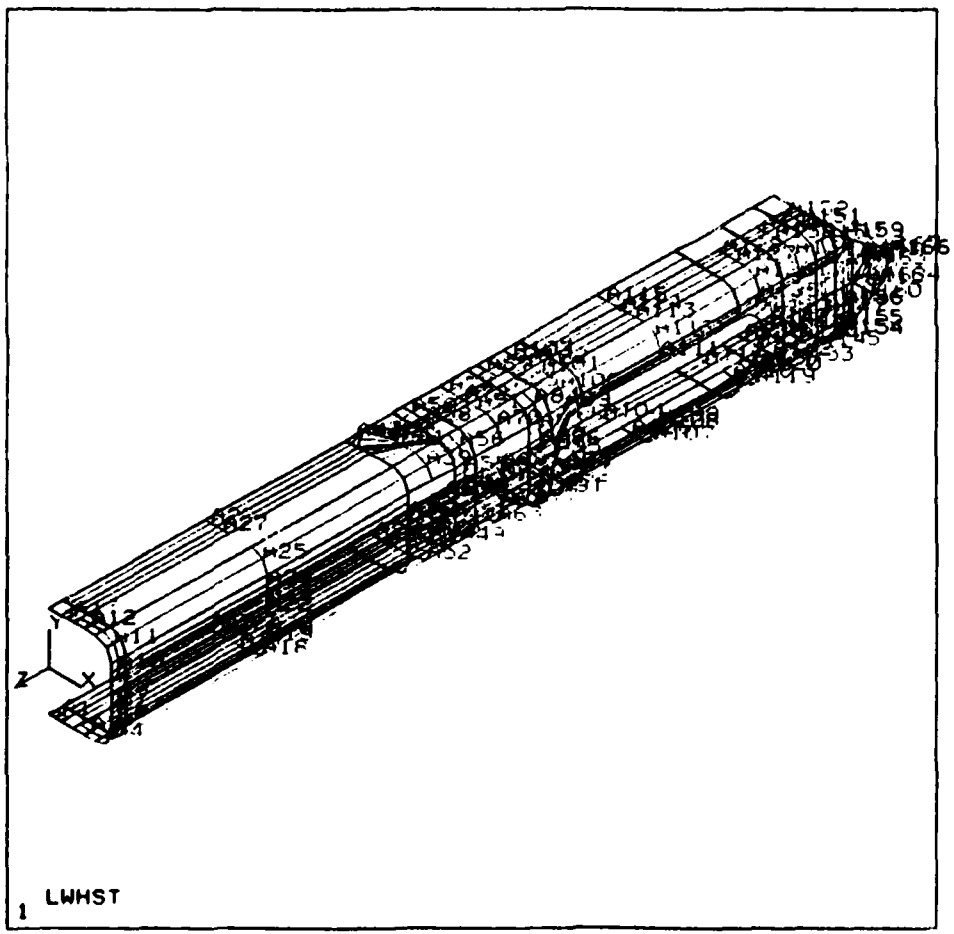
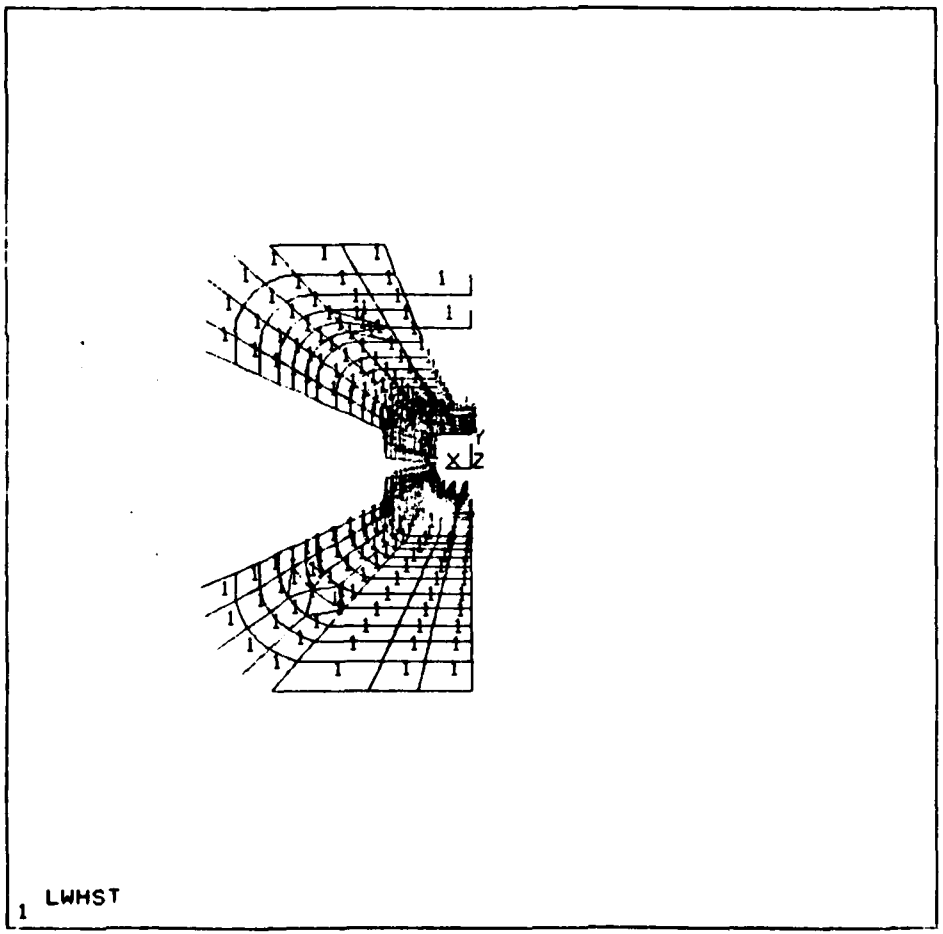
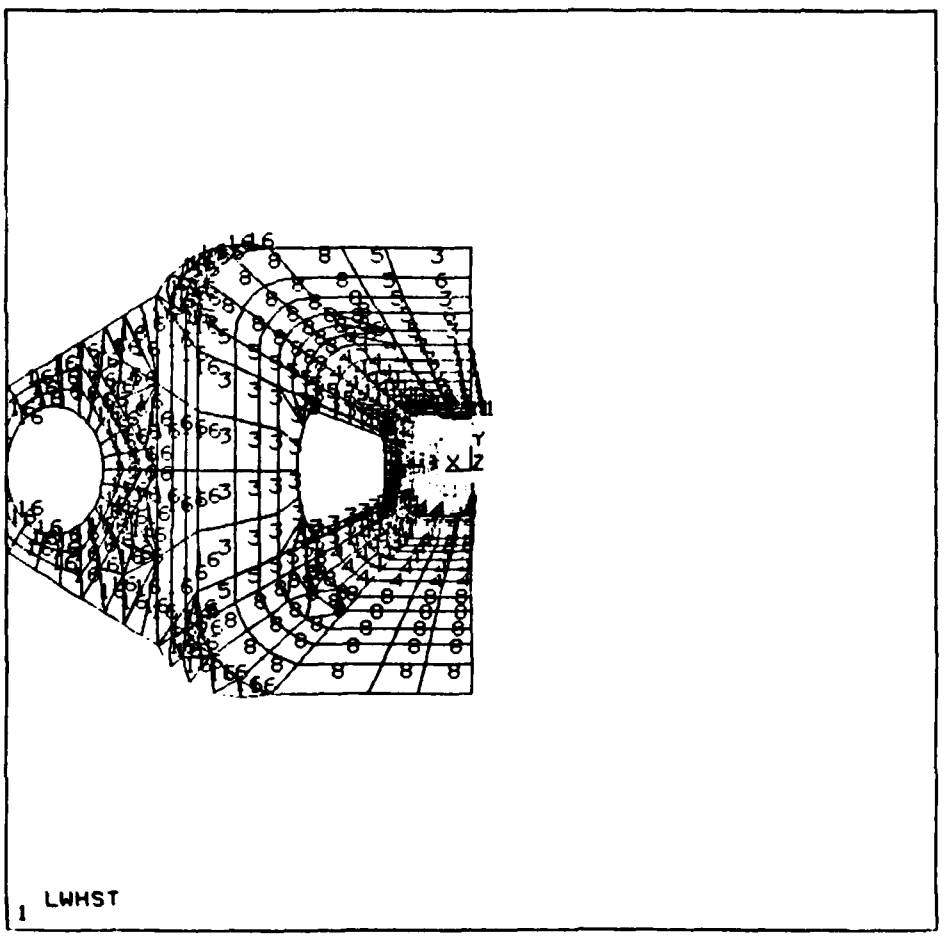
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115


ANSYS 4.2B
FEB 6 1987
8:54:04
PLOT NO. 3
PREP7 AREAS
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.33
ZF=-116
LWHST
1



ANSYS 4.2B
FEB 6 1987
8:54:38
PLOT NO. 4
PREP7 ELEMENTS
TNUM=1

ZV=-1
* DIST=139
* ZF=-119
CONE=40



ANSYS 4.2B
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8:55:01
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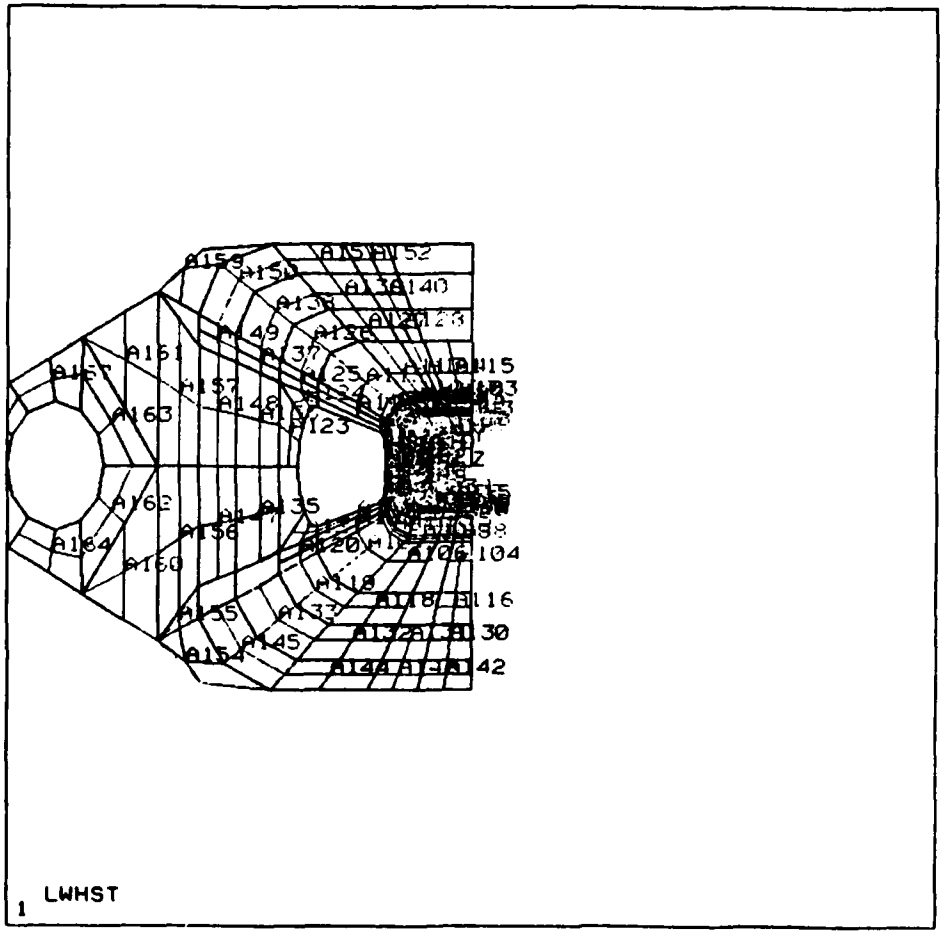
ZV=-1
* DIST=139
* ZF=-119
CONE=40



ANSYS 4.2B
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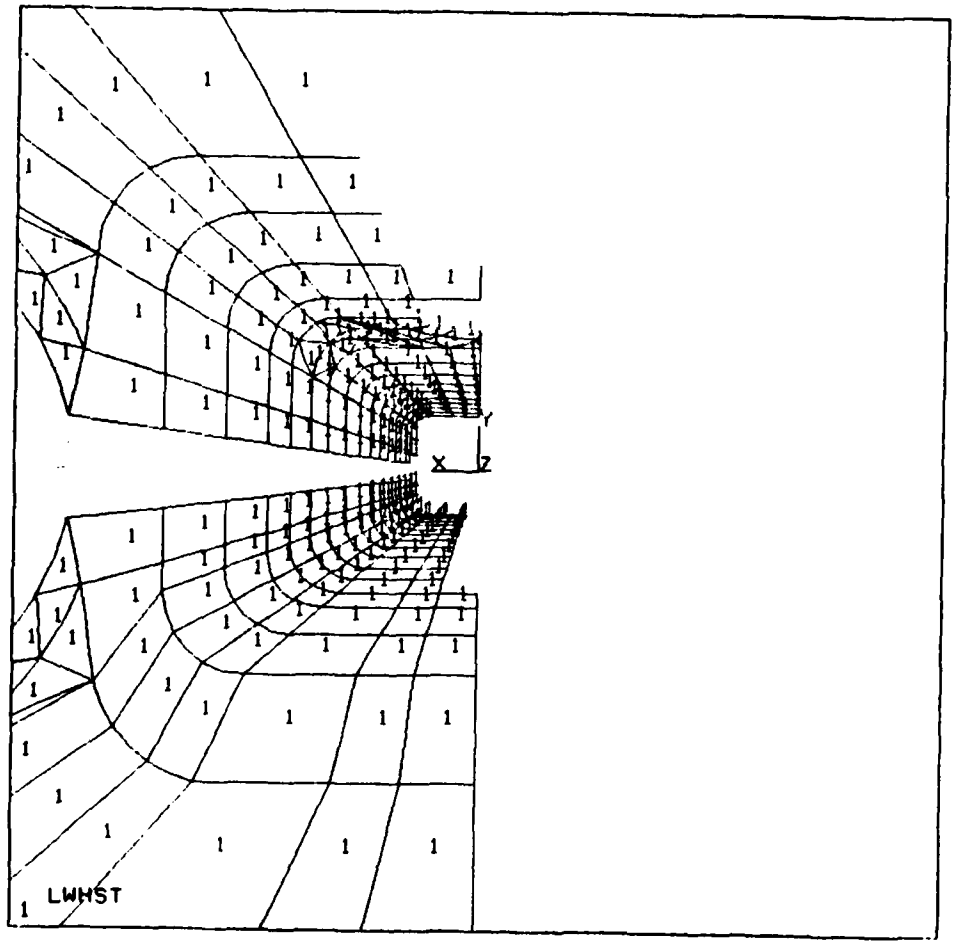
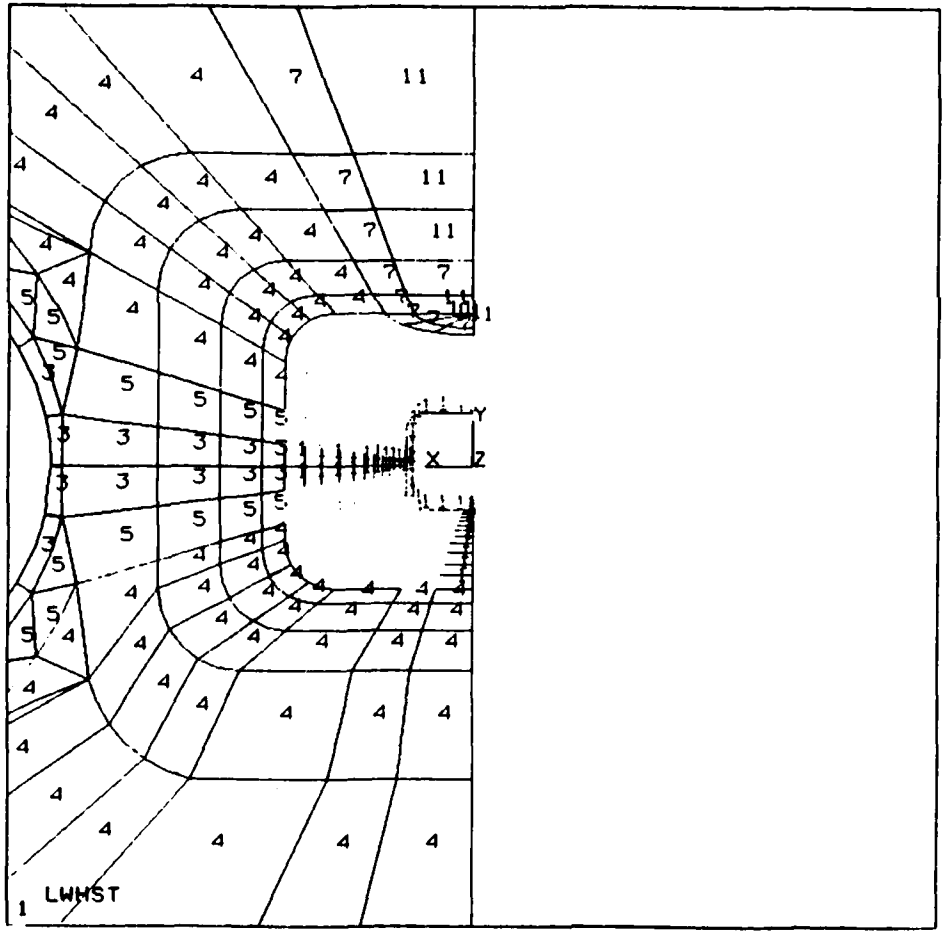
8:55:49
PLOT NO. 6
PREP7 AREAS

ZV=-1
* DIST=139
* ZF=-119
CONE=40



ANSYS 4.2B
FEB 6 1987
8:56:23
PLOT NO. 7
PREP7 ELEMENTS
TNUM=1

ZV=-1
* DIST=160
CONE=40



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8:56:38
PLOT NO. 8
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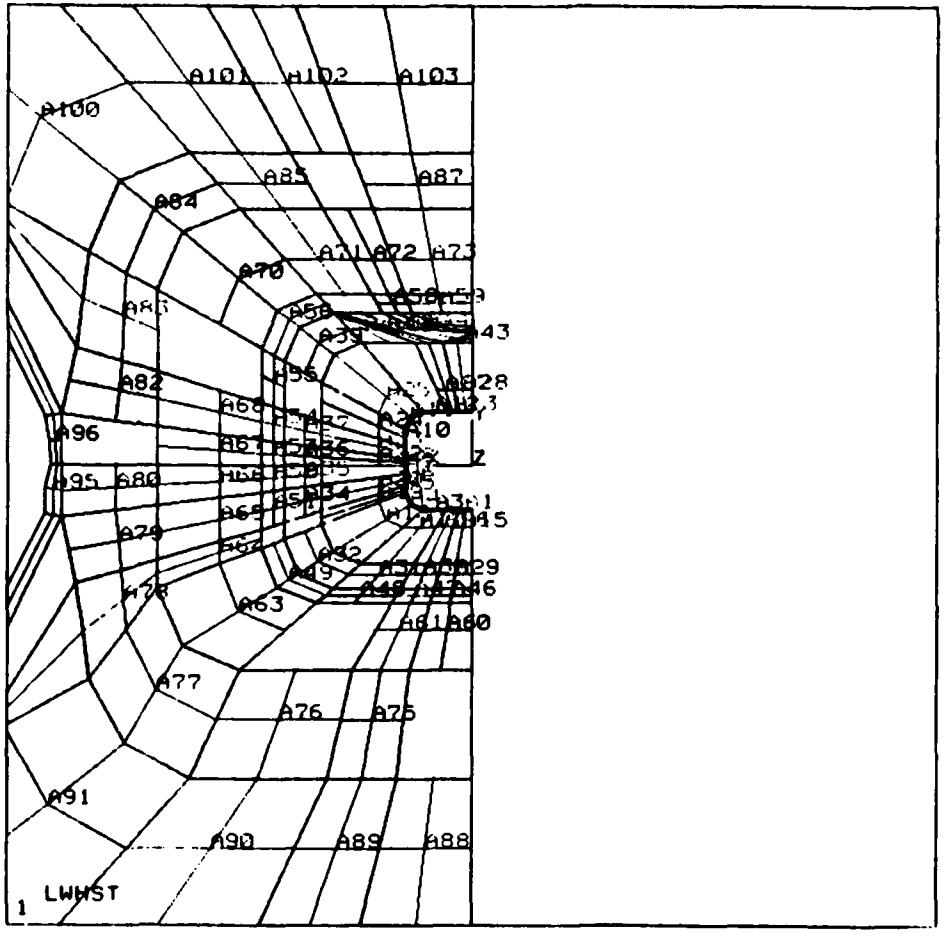
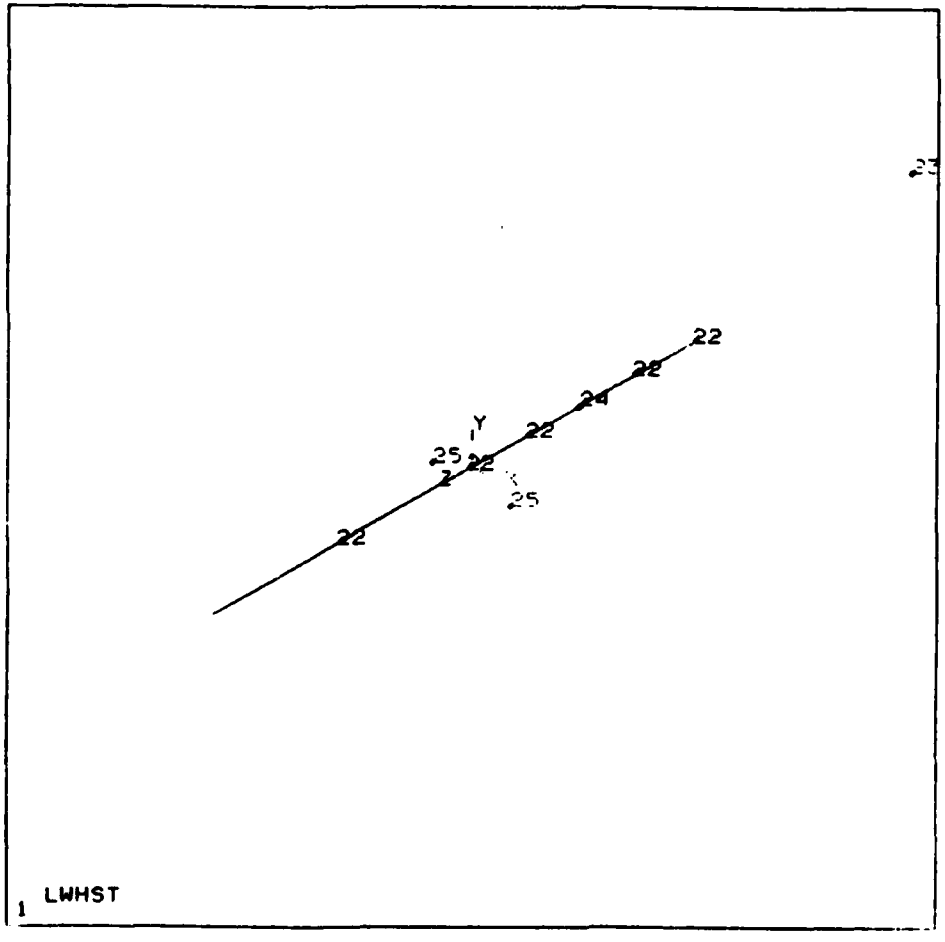
ZV=-1
* DIST=160
CONE=40



ANSYS 4.2B
FEB 6 1987
8:56:54
PLOT NO. 9
PREP7 AREAS

ZV=-1
* DIST=160
CONE=40



ANSYS 4.2B
FEB 6 1987
8:57:36
PLOT NO. 10
PREP7 ELEMENTS
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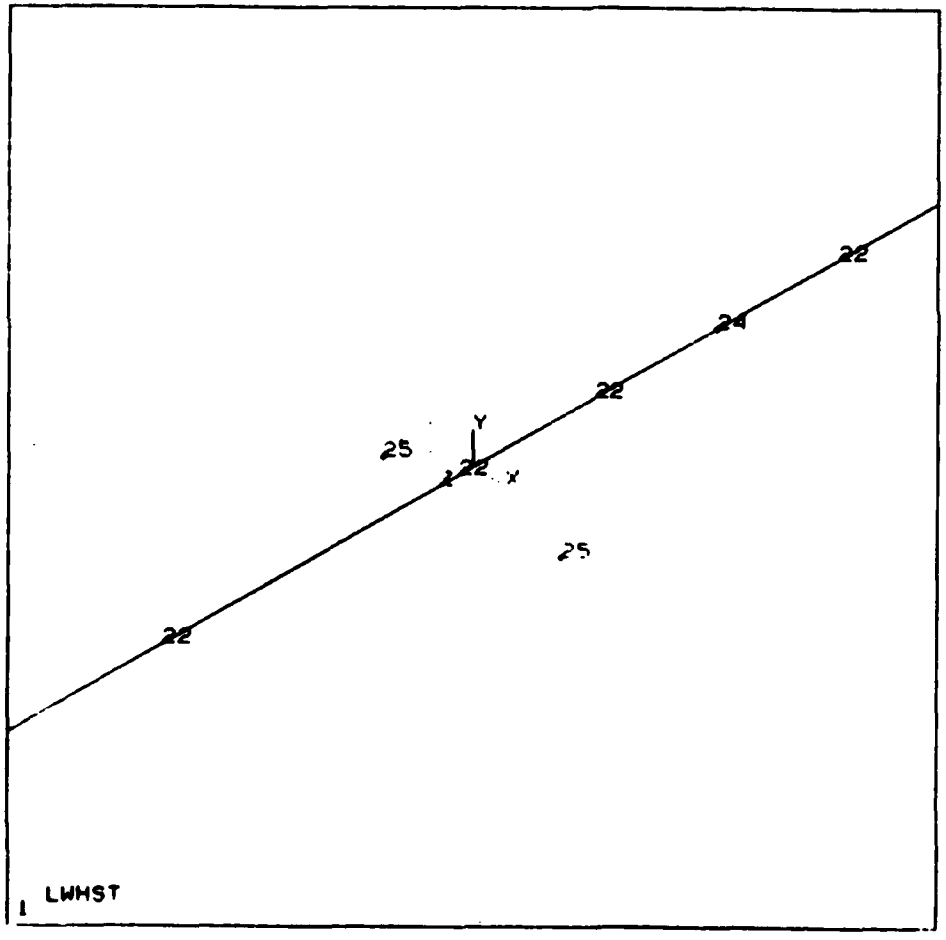
XV=1
YV=1
ZV=1
# DIST=160



ANSYS 4.2B
FEB 6 1987
8:57:36
PLOT NO. 10
PREP7 ELEMENTS
RNUM=1

XV=1
YV=1
ZV=1
* DIST=70

D2/260

MCR MEMO: FEBRUARY 5, 1987

MCR
ASSOCIATES, INC.

111 W. Evelyn Ave., Suite 301
Sunnyvale, California 94086
(408) 736-1636

February 5, 1987

Hans.

Model 11

Larry Libhardt
FMC Corporation
3989 Central Ave NE
Minneapolis, Minn 55421

Dear Larry,

Here are the results for model 11. We made all of the thickness changes as shown on the drawings you sent to us. The enclosed table shows the REAL#'s, their properties and the areas that were assigned to that property. The set of element and area plots are also included as well as an input listing. The same set of contour plots are also included. We will plan to perform a transient analysis this weekend although we will probably reduce the number of elements from 3 around the radius to 2 to decrease the wavefront and the required disk space. The static run is using 185 mb of disk and we do not feel that there is enough disk space to run a transient which would probably require at least 300 mb. The model has been built in a parametric way so that reducing its size should not require excessive man-time (about 3-4 hours). Also, the model accuracy should not be as crucial for a dynamic analysis as for extracting stress results. We will send you the dynamic results on Monday of next week.

Best regards,

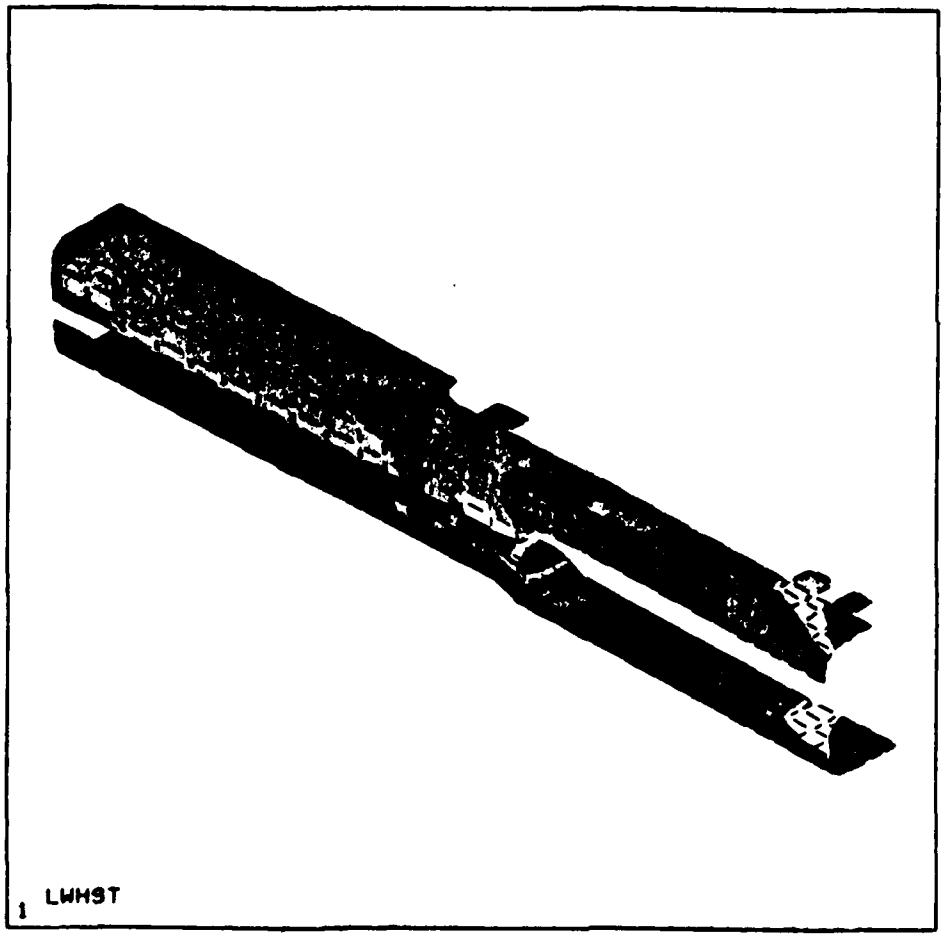
Mark C. Rodamaker

Mark C. Rodamaker

REAL#	PROPERTIES	AREAS	
1	.081 P	1-14, 15,29, 21-22, 35-36	blue
	.0405 P		
2	2 C	17-19, 24-28, 31-33,38-43	yellow
	.0405 P		
3	.324 P	52-53, 66-67, 80-81, 94-97, 109,110, 121-124,129,135-136,141,147-148, 153	orange
	.0675 P	46-50, 55-57, 60-64, 69-71	
4	2 C	74-78, 83-85, 88-92, 99-101,104-107	blue
	.0675 P	112-113	
5	.162 P	51,54,65,68,79,82,93,98	chartruse
	1 C	108,111,120,125,128,134,137,140	
	.162 P	146,149,152	
7	.135 P		red
	1 C	44,58,72,86,102,114	
	.135 P		
8	.135 P	116-119, 126-127, 130-133, 138-139	red
	2 C	142-145, 150-151	
	.135 P		
9	.0405 P		
	1 C	16, 20, 23, 30, 34, 37	
	.0405 P		
11	.270 P	45, 59, 73, 87, 103, 115	green
16	.81 P	154-167	blue

FIGURE 1

RECOIL

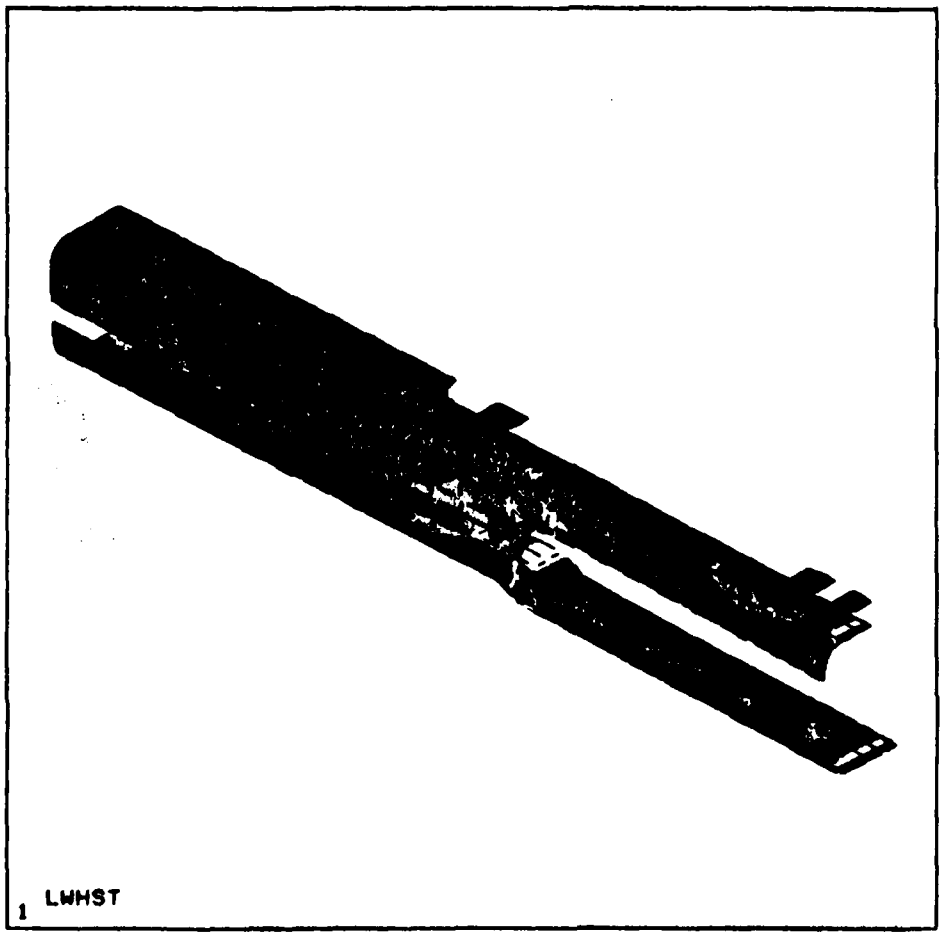


ANSYS 4.2B
FEB 6 1987
8:16:19
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=2110
MN=-10539
-9136
-7730
-6324
-4918
-3512

FIGURE 2

RECOIL

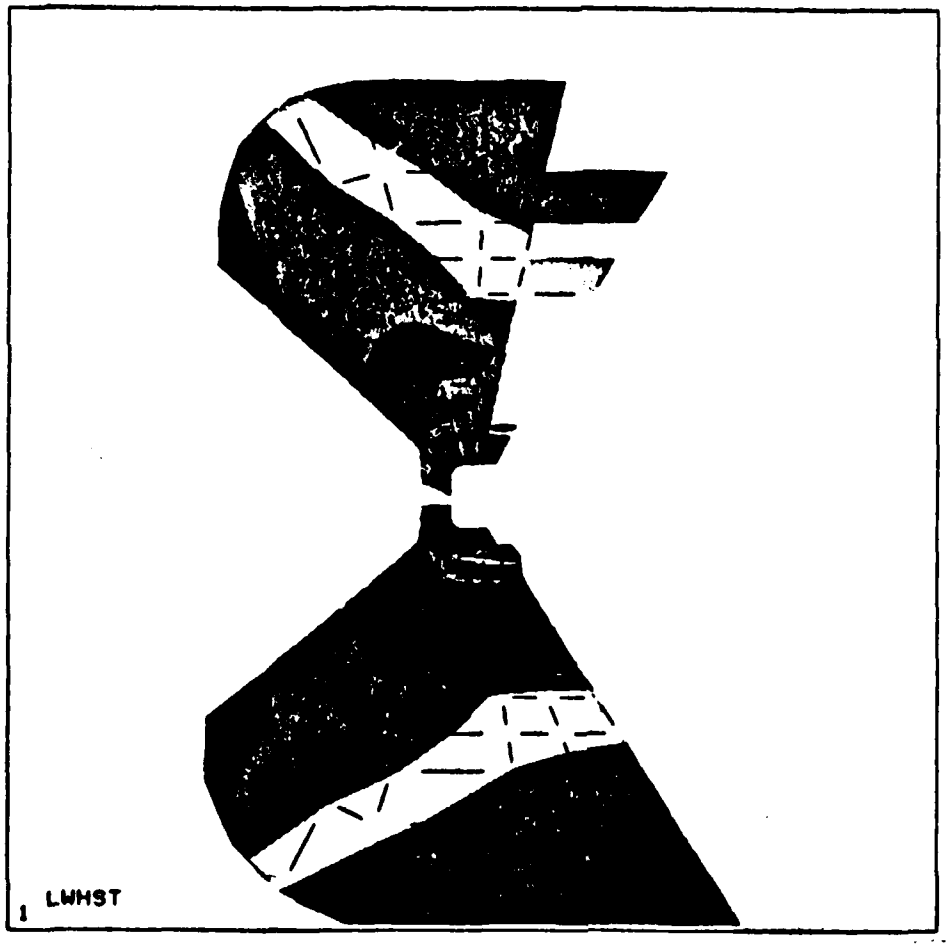


ANSYS 4.2B
FEB 6 1987
8:16:47
PLOT NO. 2
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=4756
MN=-2788
-1953
-1114
-275
564
1403

FIGURE 3

RECOIL



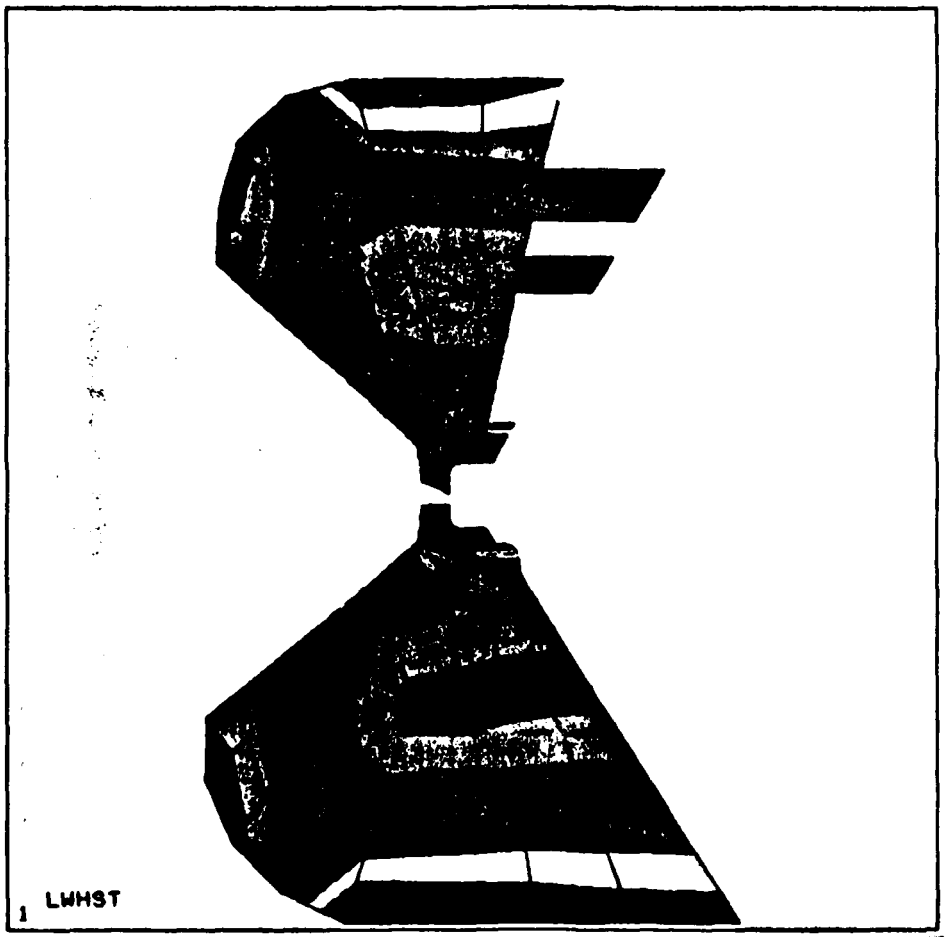
ANSYS 4.2B
FEB 6 1987
8:17:12
PLOT NO. 3
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=2110
MN=-10539
-9136
-7730
-6324
-4918
-3512

706
2112

FIGURE 4

RECOIL



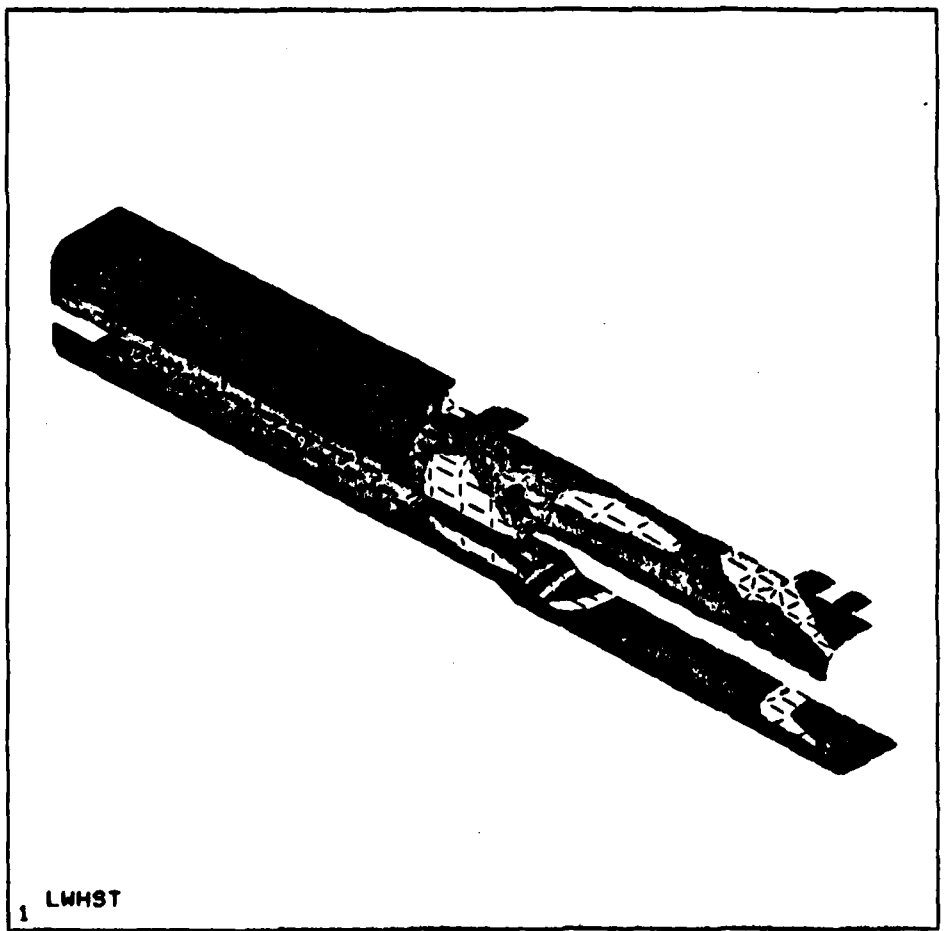
ANSYS 4.2B
FEB 6 1987
8:17:35
PLOT NO. 4
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=4756
MN=-2788
-1953
-1114
-275
564
1403

3920
4759

FIGURE 5

RECOIL

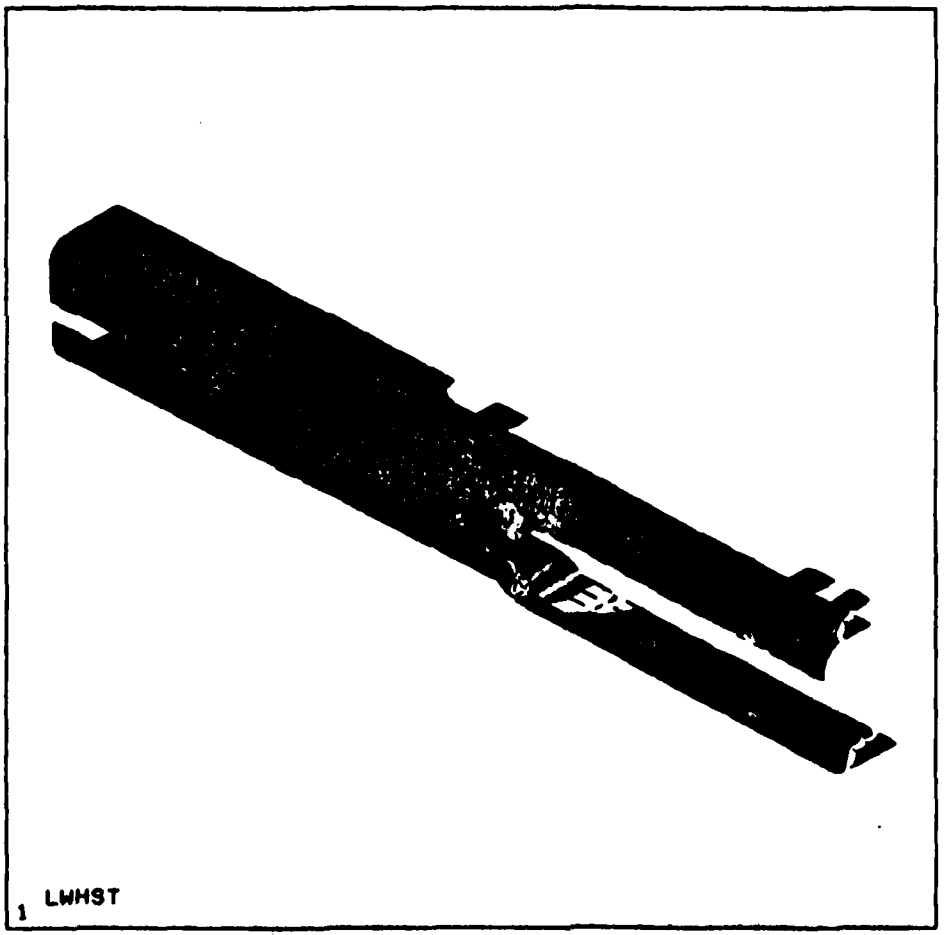


ANSYS 4.2B
FEB 6 1987
8:18:15
PLOT NO. 5
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=1564
MN=-11972
-10468
-8964
-7460
-5956
-4452

FIGURE 6

RECOIL

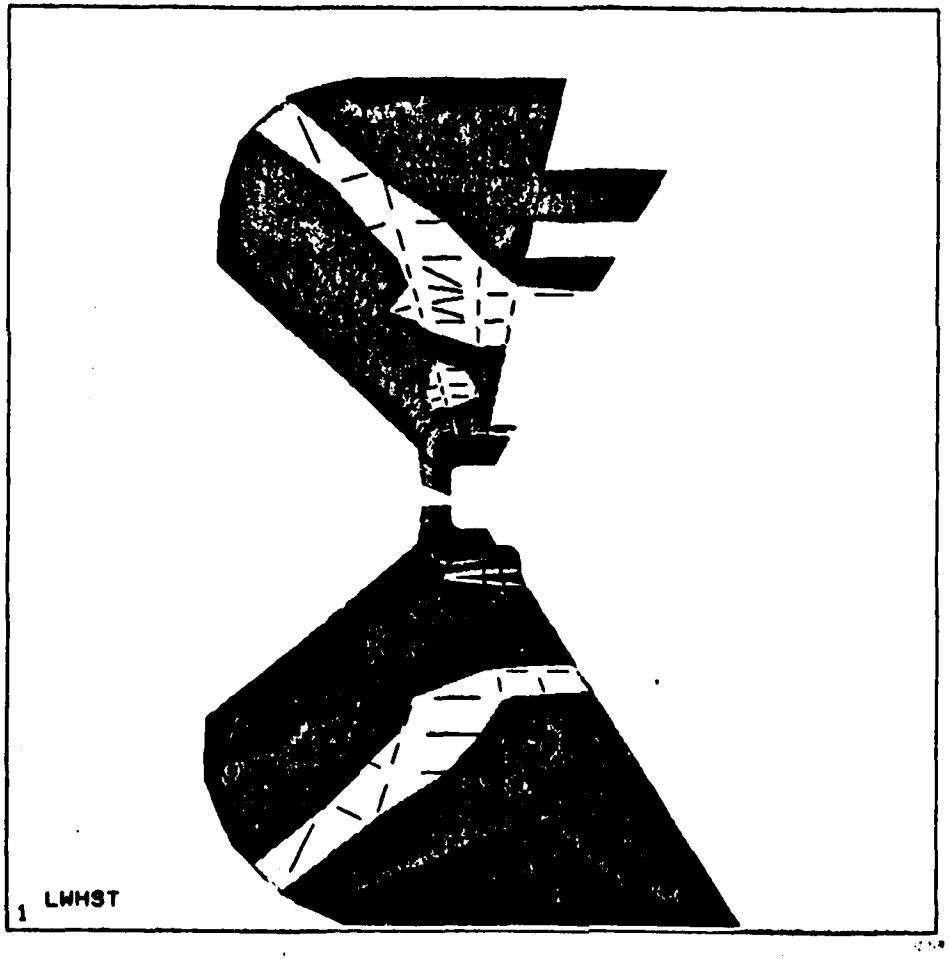


ANSYS 4.2B
FEB 6 1987
8:18:38
PLOT NO. 6
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=3434
MN=-3296
-2549
-1801
-1053
-305
443

FIGURE 7

RECOIL



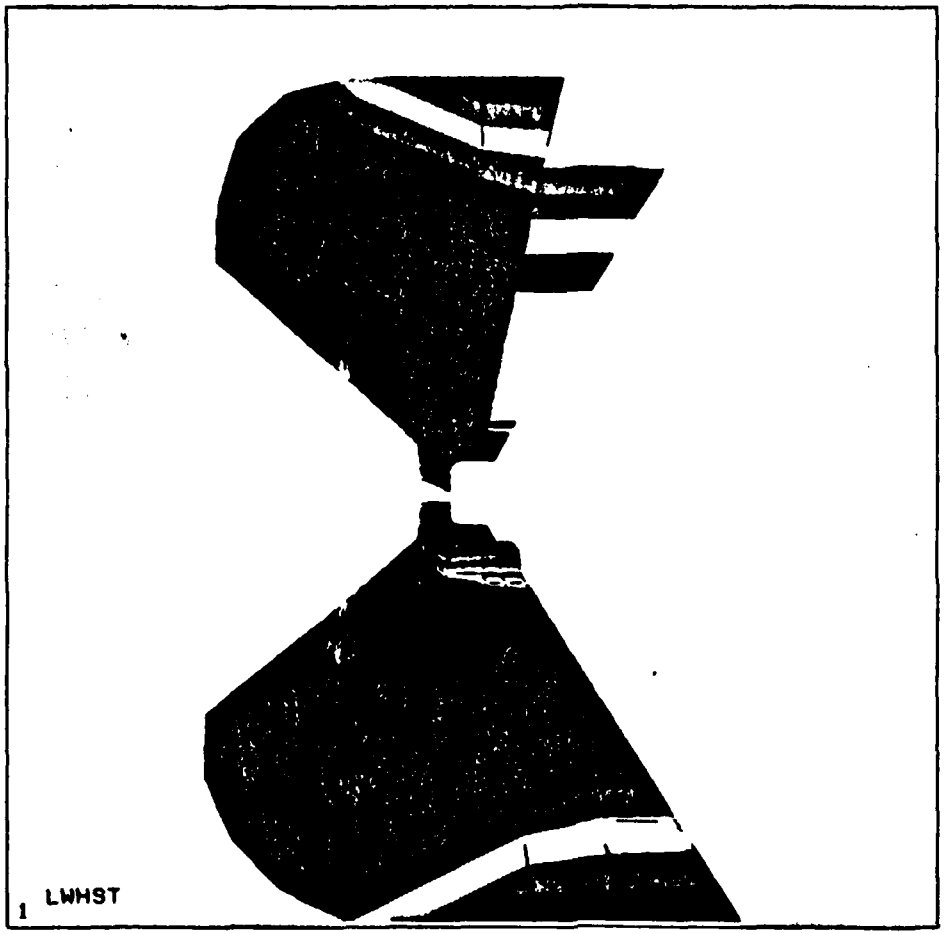
ANSYS 4.2B
FEB 6 1987
8:19:01
PLOT NO. 7
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=1564
MN=-11972
-10468
-8964
-7460
-5956
-4452

60.4
1564

FIGURE 8

RECOIL



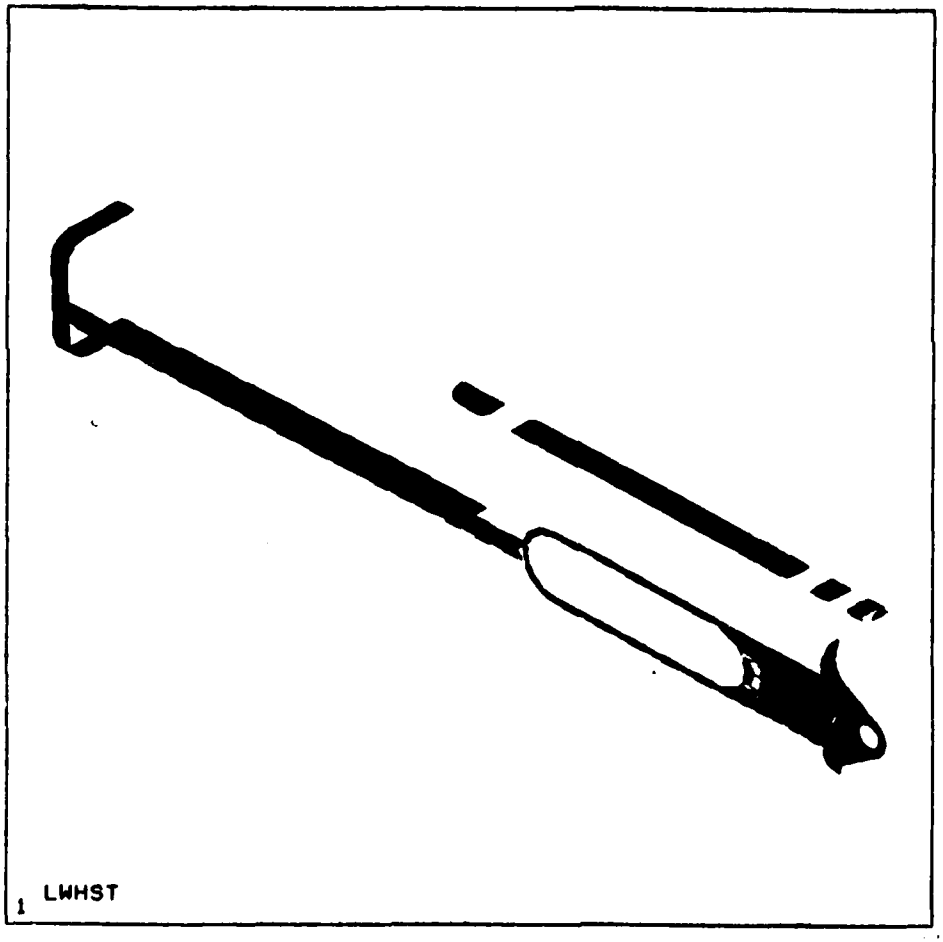
ANSYS 4.2B
FEB 6 1987
8:19:25
PLOT NO. 8
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=3434
MN=-3296
-2549
-1801
-1053
-305
443

2687
3435

FIGURE 9

RECOIL

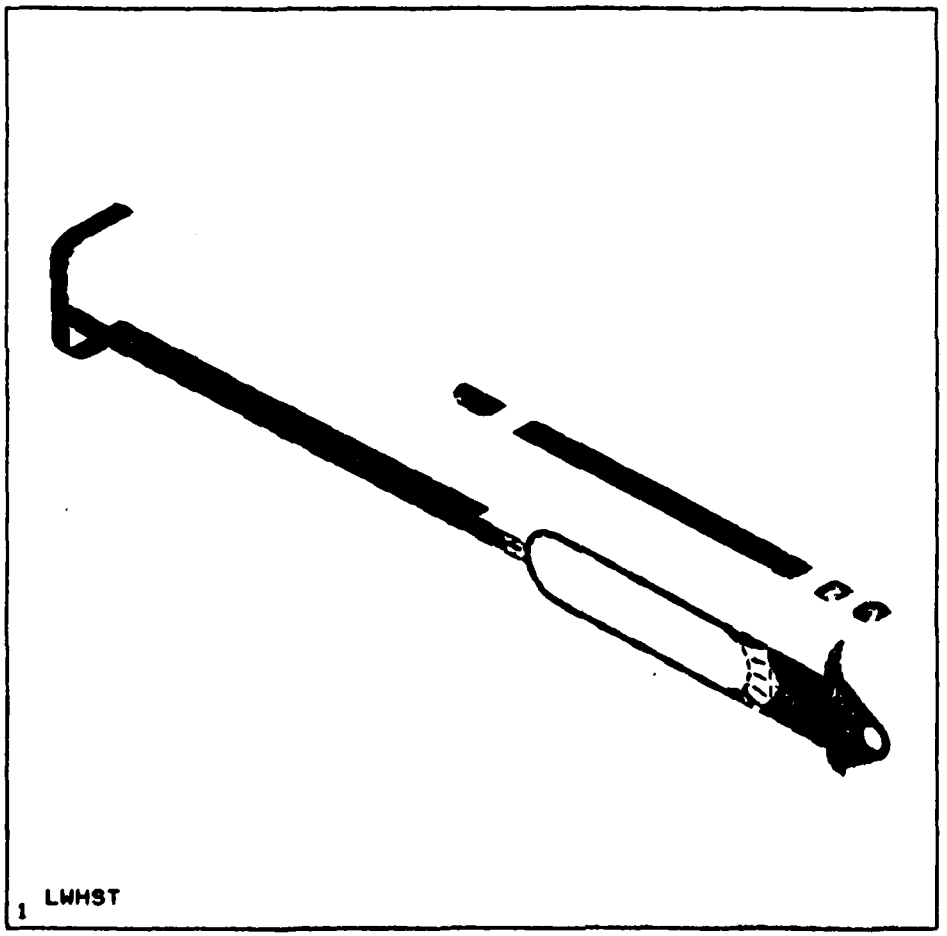


ANSYS 4.2B
FEB 6 1987
8:20:11
PLOT NO. 9
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=7175
MN=-6589
-5062
-3532
-2002
-472
1058

FIGURE 10

RECOIL

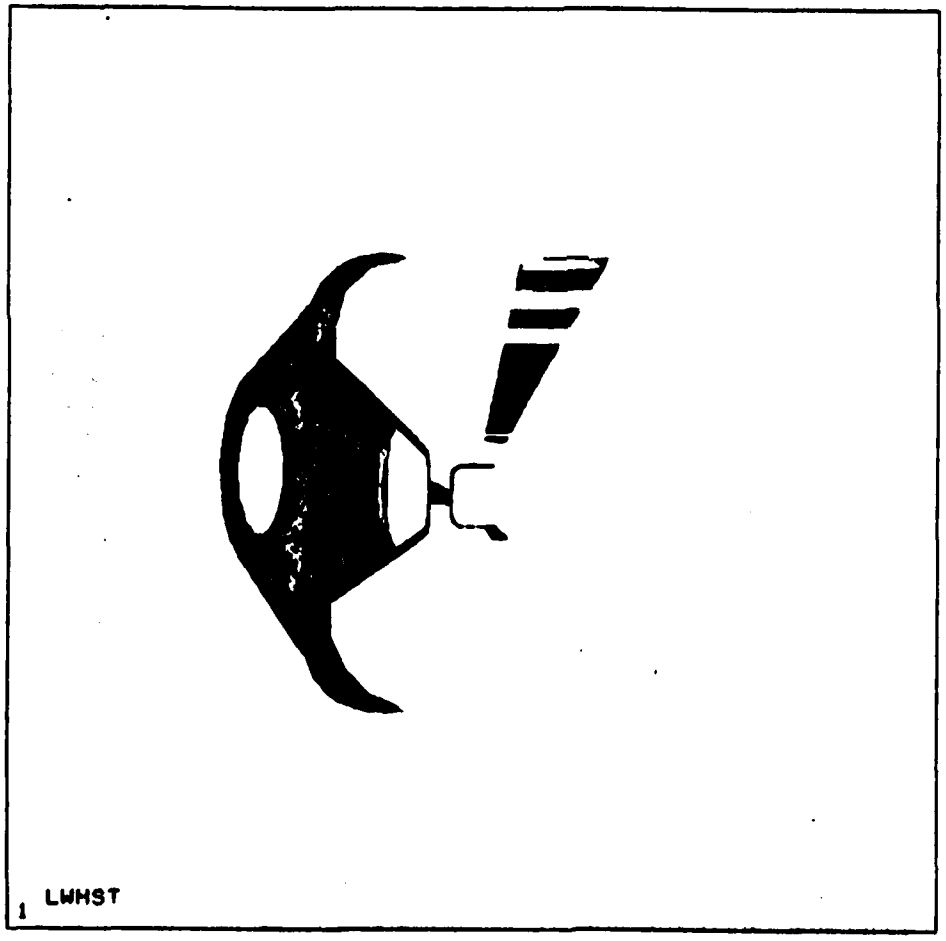


ANSYS 4.2B
FEB 6 1987
8:20:25
PLOT NO. 10
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=4515
MN=-11675
-9877
-8078
-6279
-4480
-2681

FIGURE 11

RECOIL

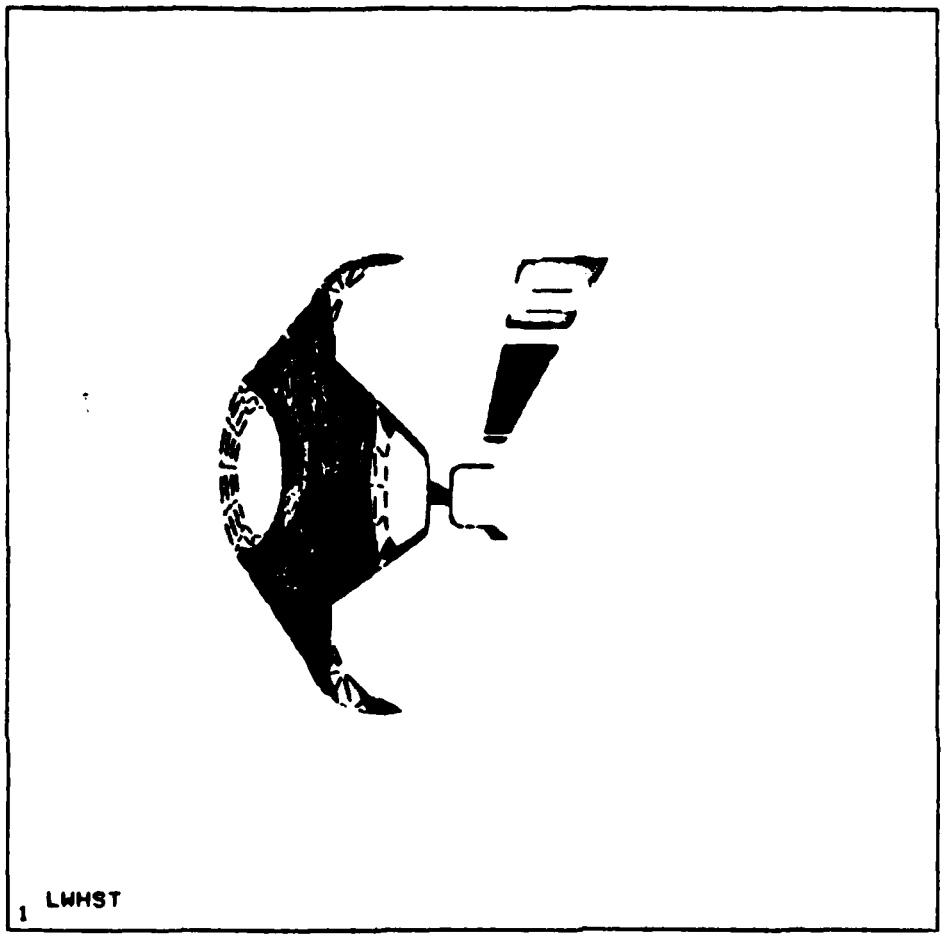


ANSYS 4.2B
FEB 6 1987
8:20:40
PLOT NO. 11
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=7175
MN=-6589
-5062
-3532
-2002
-472
1058
5648
7178

FIGURE 12

RECOIL



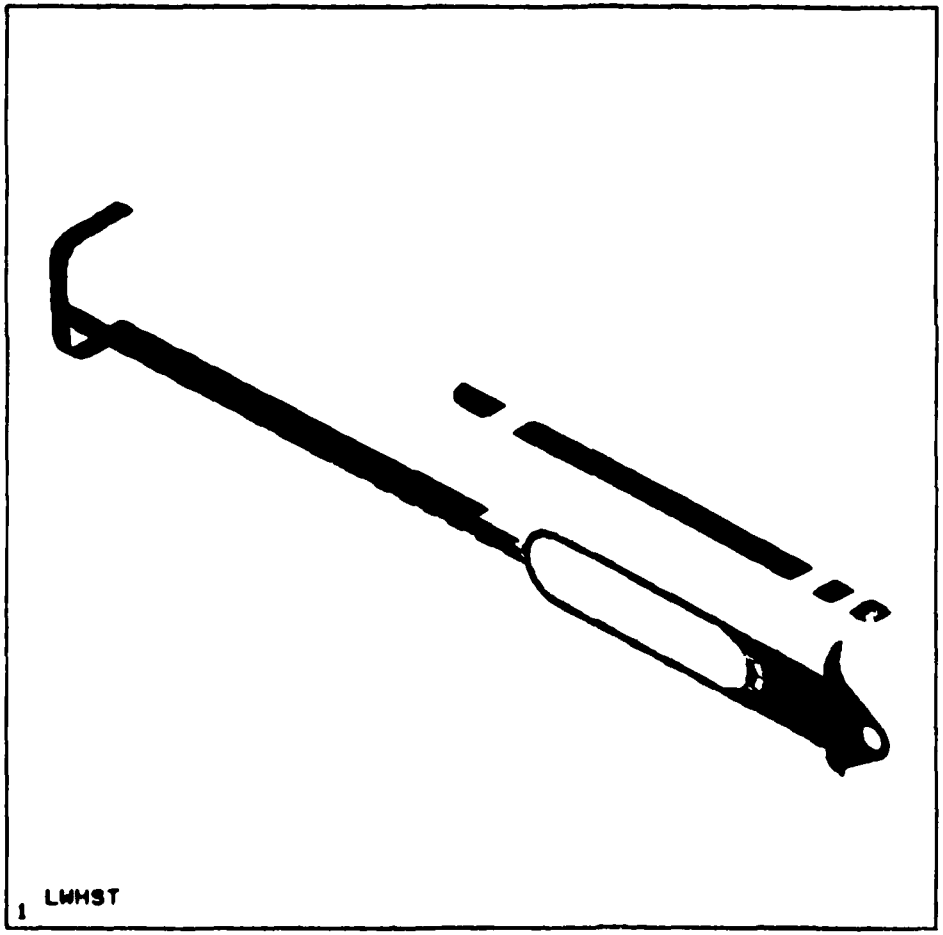
ANSYS 4.2B
FEB 6 1987
8:20:53
PLOT NO. 12
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=4515
MN=-11675
-9877
-8078
-6279
-4480
-2681

2716
4515

FIGURE 13

RECOIL

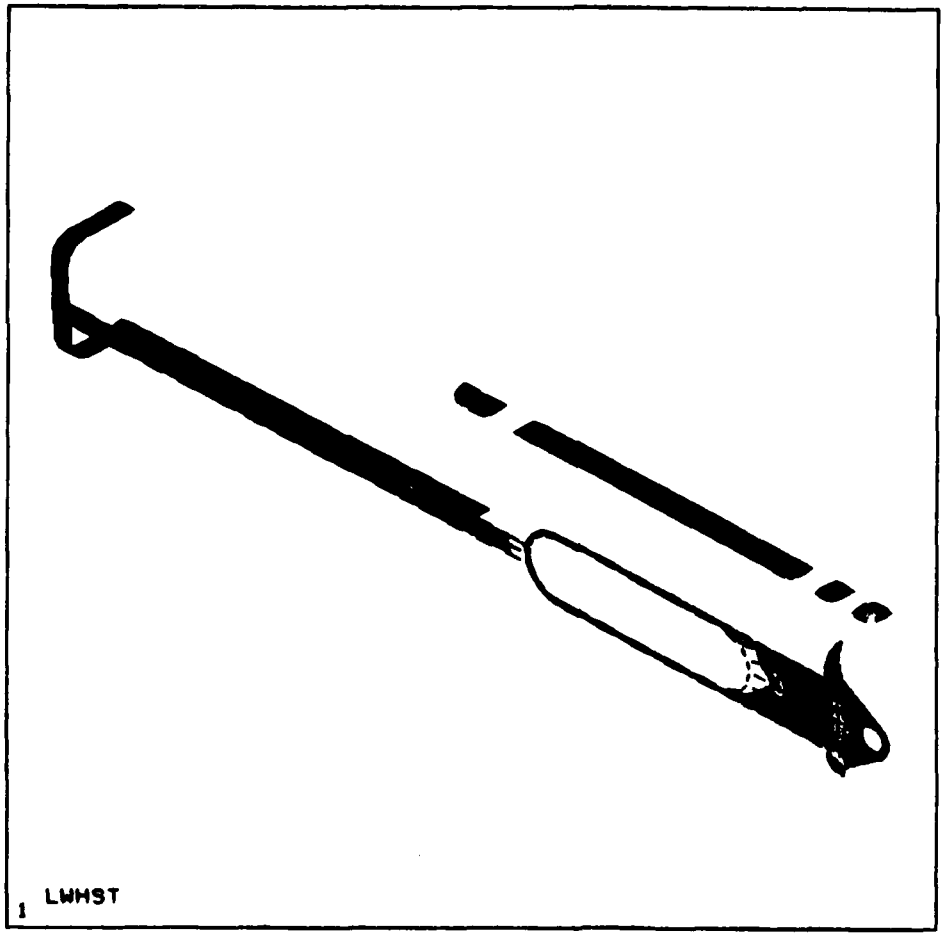


ANSYS 4.2B
FEB 6 1987
8:21:18
PLOT NO. 13
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=6698
MN=-6737
-5245
-3752
-2259
-766
727

FIGURE 14

RECOIL



ANSYS 4.2B
FEB 6 1987
8:21:31
PLOT NO. 14
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=4275
MN=-9681
-8131
-6580
-5029
-3478
-1927

FIGURE 15

RECOIL

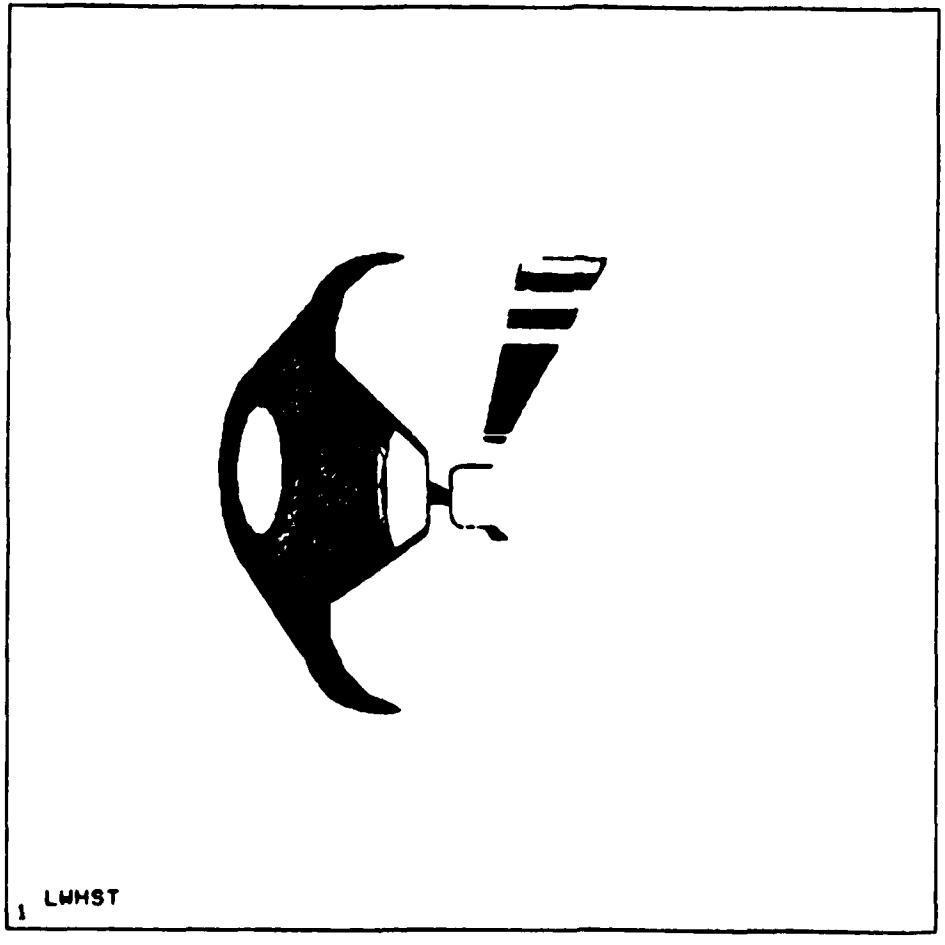
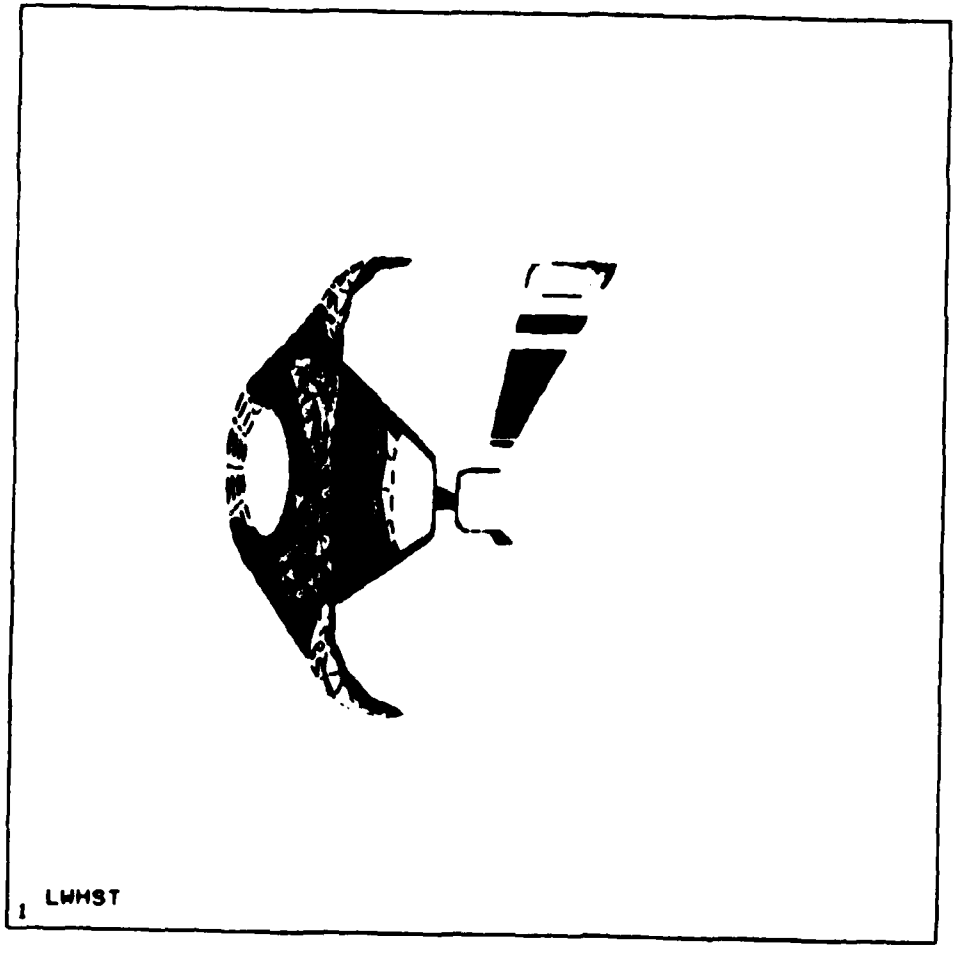


FIGURE 16

RECOIL



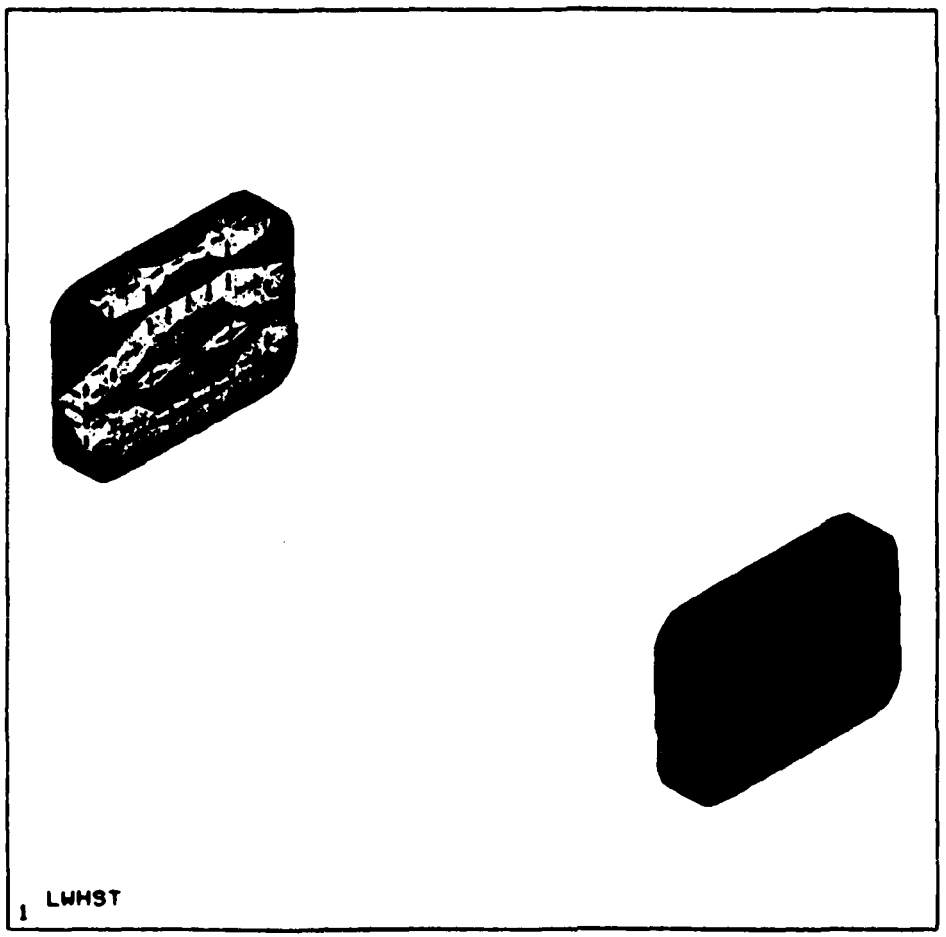
ANSYS 4.2B
FEB 6 1987
8:21:58
PLOT NO. 16
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=4275
MN=-9681
-8131
-6580
-5029
-3478
-1927

2726
4277

FIGURE 17

RECOIL

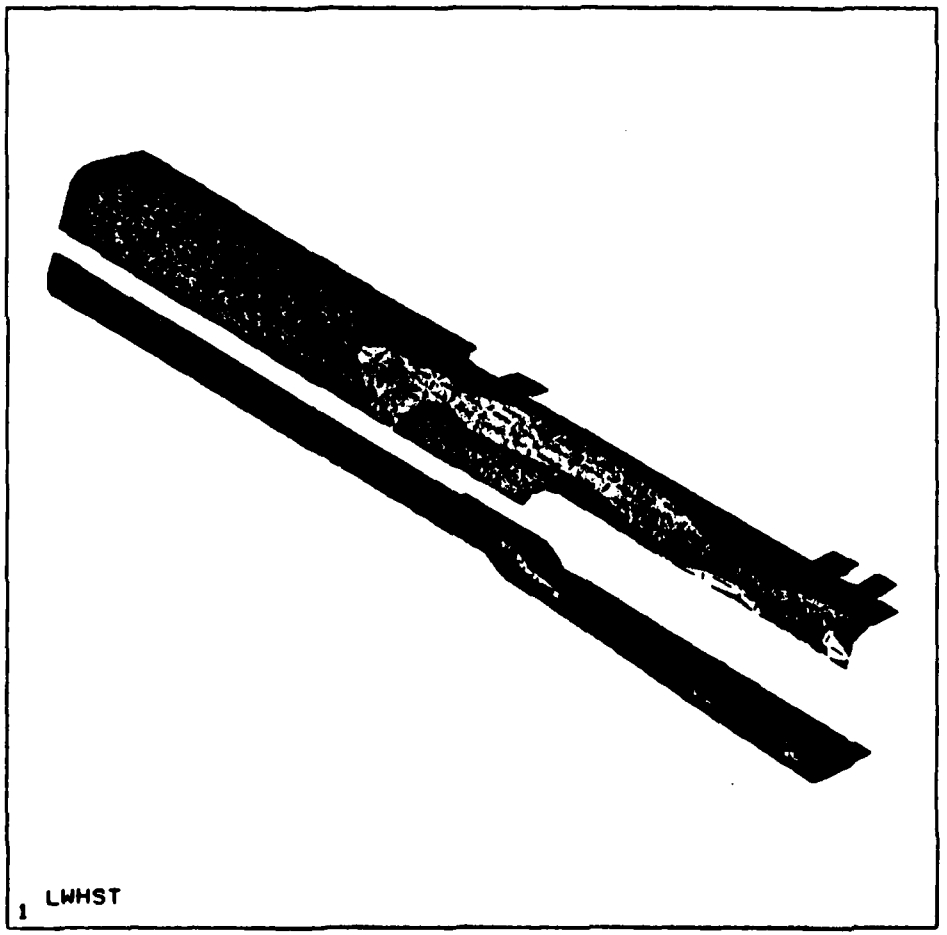


ANSYS 4.2B
FEB 6 1987
8:22:30
PLOT NO. 17
POST1 STRESS
STEP=1
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2120
MN=5.03
237
473
709
945
1181
.
.
.
1889
2125

FIGURE 18

TORQUE

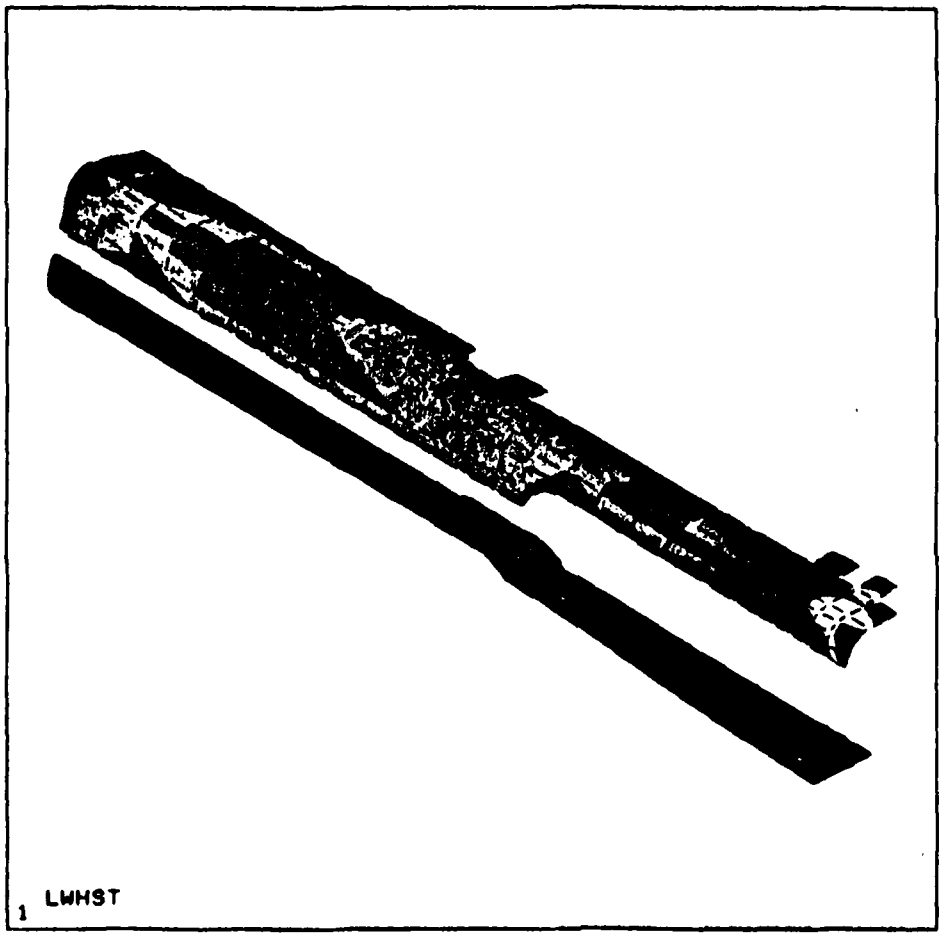


ANSYS 4.2B
FEB 6 1987
8:24:44
PLOT NO. 18
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=22326
MN=-19561
-14910
-10255
-5600
-945
3710

FIGURE 19

TORQUE

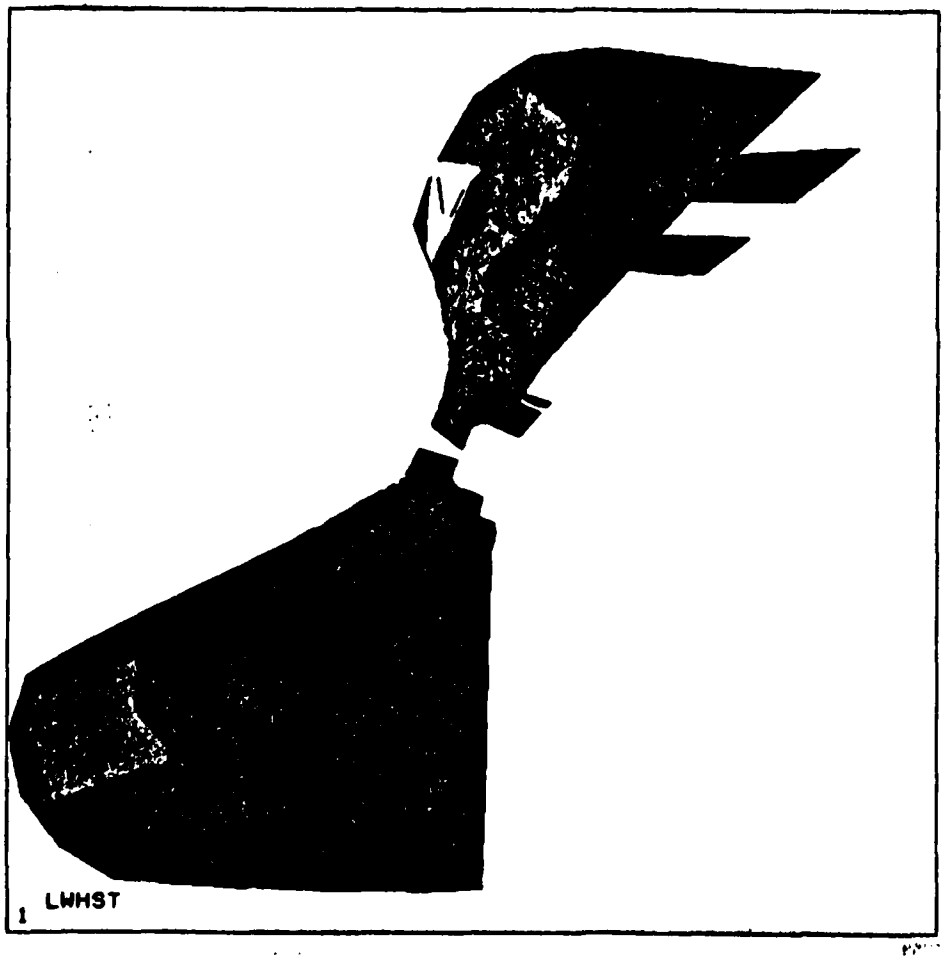


ANSYS 4.2B
FEB 6 1987
8:25:11
PLOT NO. 19
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=26559
MN=-31968
-25469
-18965
-12461
-5957
547

FIGURE 20

TORQUE

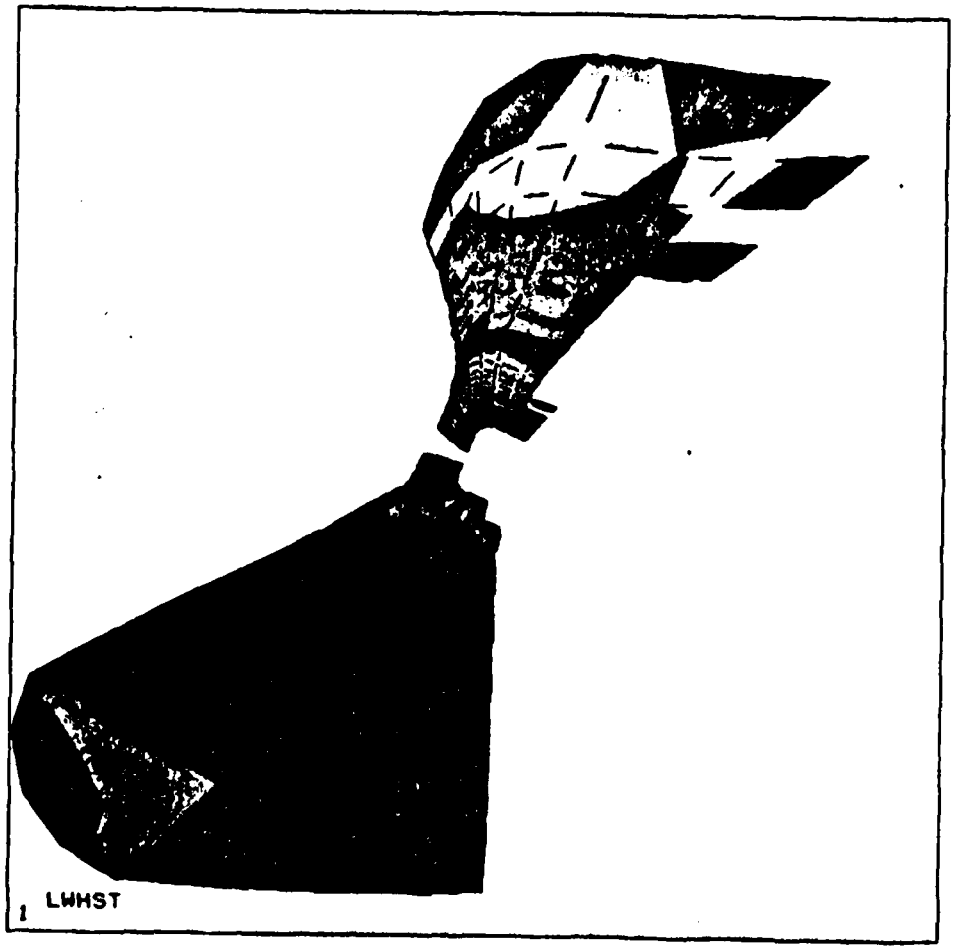


ANSYS 4.2B
FEB 6 1987
8:25:39
PLOT NO. 20
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=22326
MN=-19561
-14910
-10255
-5600
-945
3710
[illegible]
17675
22330

FIGURE 21

TORQUE



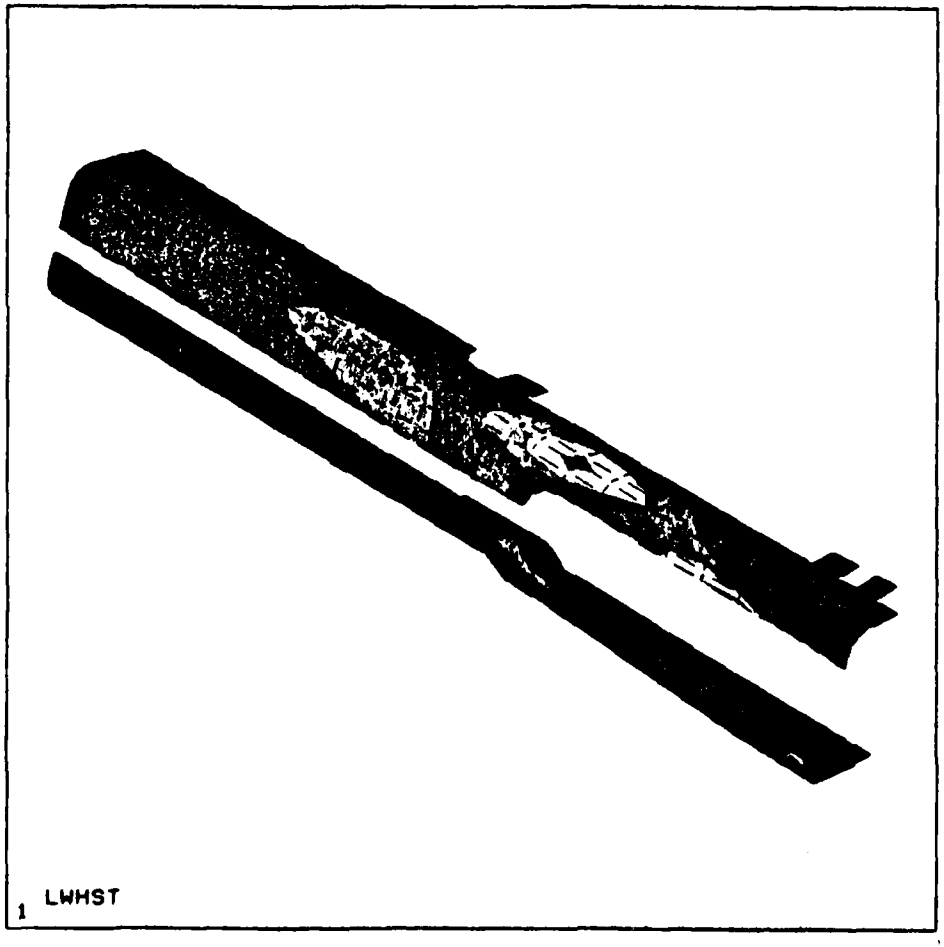
ANSYS 4.2B
FEB 6 1987
8:26:31
PLOT NO. 21
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=26559
MN=-31968
-25469
-18965
-12461
-5957
547

20059
26563

FIGURE 22

TORQUE

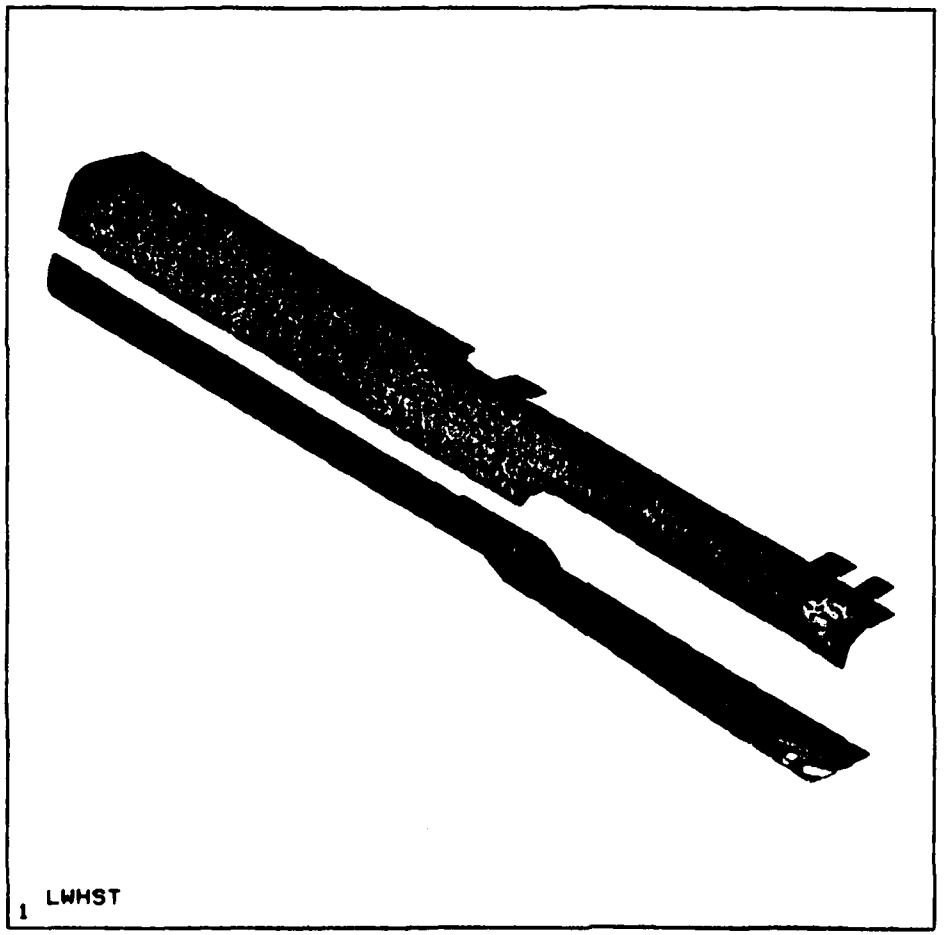


ANSYS 4.2B
FEB 6 1987
8:27:15
PLOT NO. 22
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=16854
MN=-14375
-10906
-7436
-3966
-496
2974

FIGURE 23

TORQUE

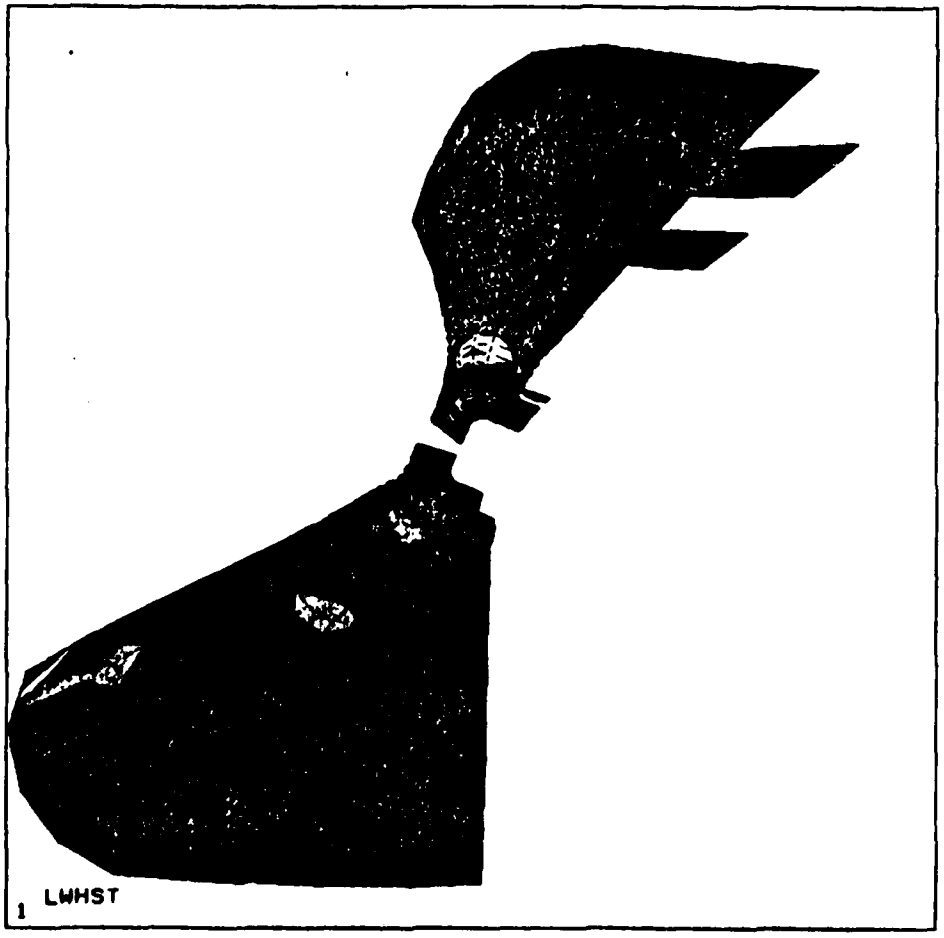


ANSYS 4.2B
FEB 6 1987
8:27:43
PLOT NO. 23
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=18529
MN=-17049
-13099
-9145
-5191
-1237
2717

FIGURE 24

TORQUE



ANSYS 4.2B
FEB 6 1987
8:28:08
PLOT NO. 24
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=16854
MN=-14375
-10906
-7436
-3966
-496
2974
[illegible]

13384
16854

FIGURE 25

TORQUE

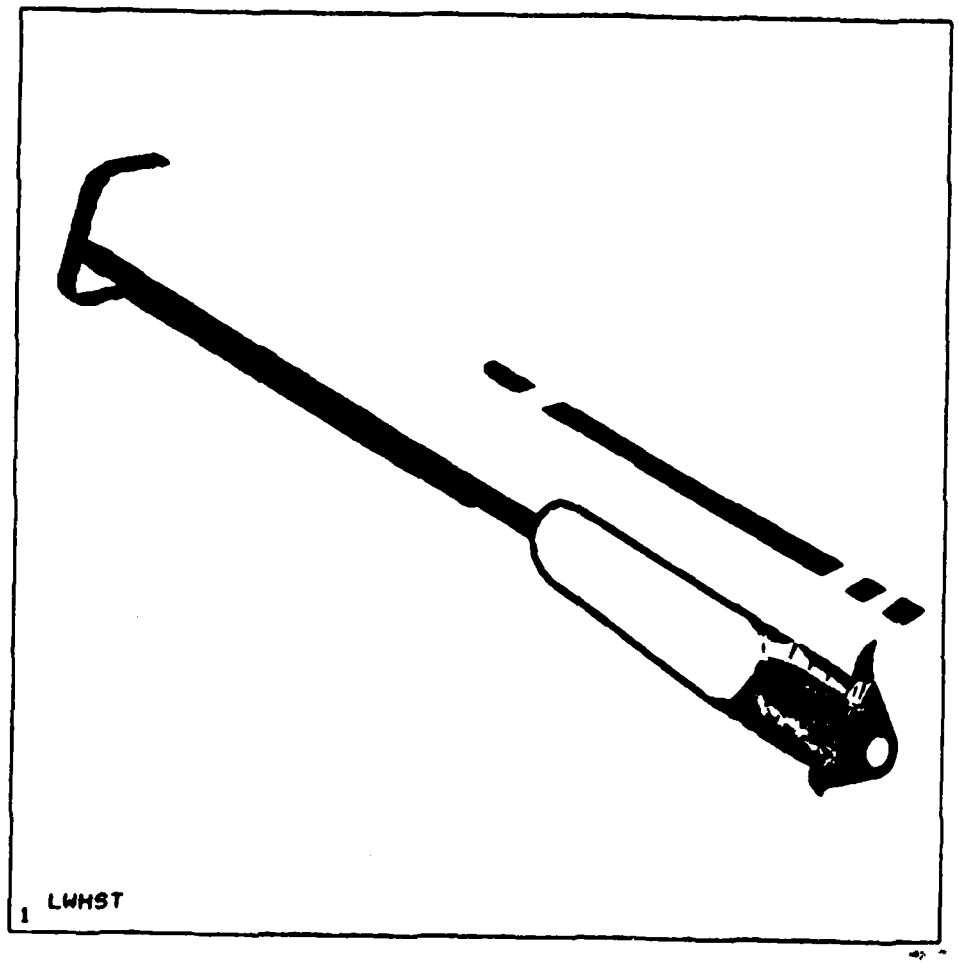
ANSYS 4.2B
FEB 6 1987
8:28:35
PLOT NO. 25
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=18529
MN=-17049
-13099
-9145
-5191
-1237
2717

14579
18533

FIGURE 26

TORQUE

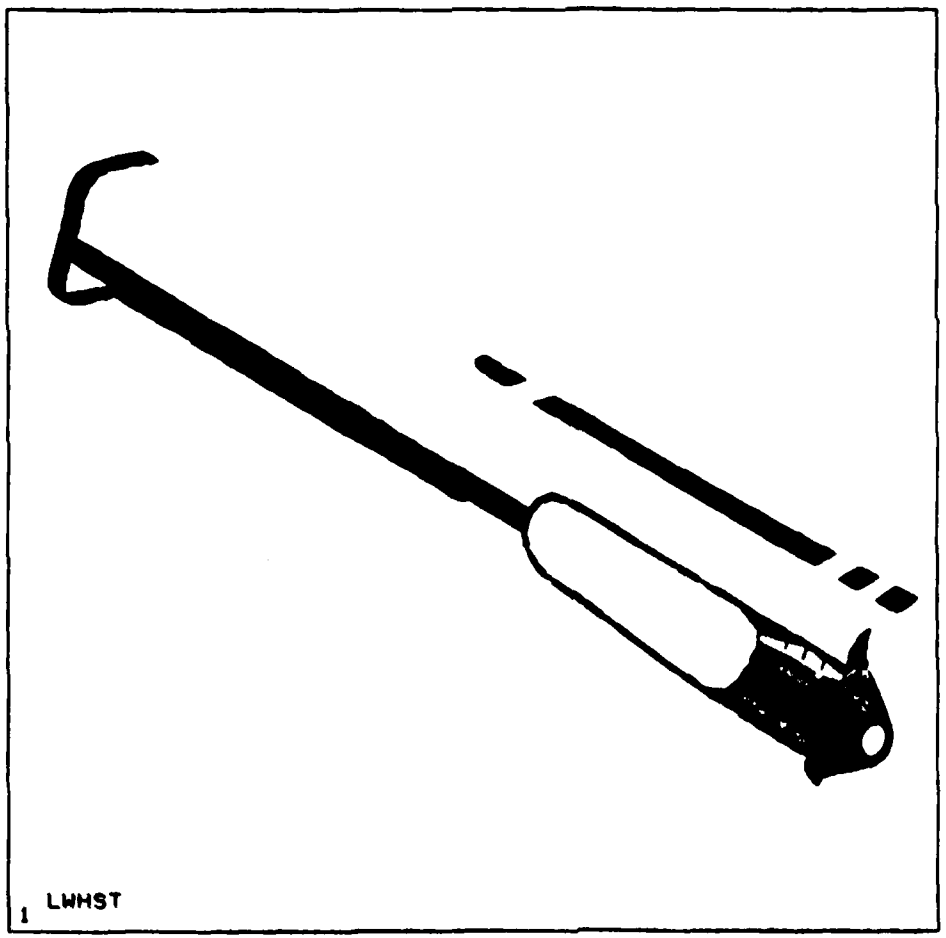


ANSYS 4.2B
FEB 6 1987
8:29:24
PLOT NO. 26
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=39133
MN=-33113
-25088
-17060
-9032
-1004
7024

FIGURE 27

TORQUE

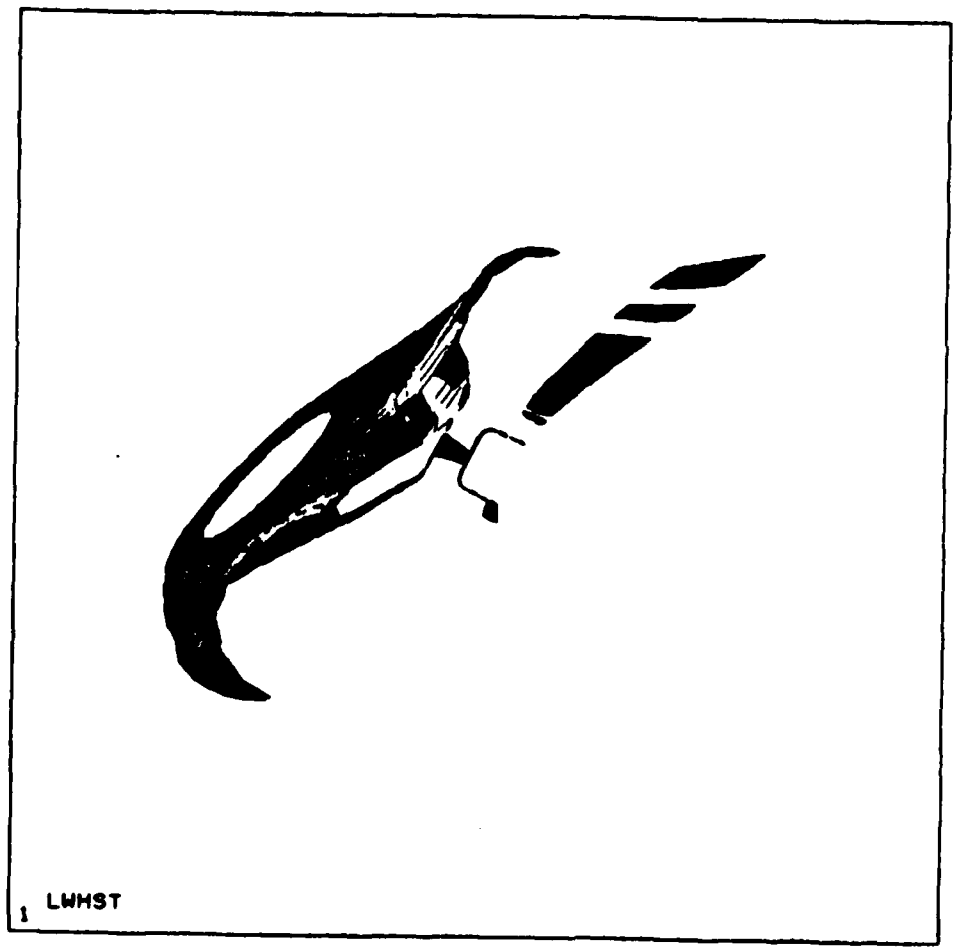


ANSYS 4.2B
FEB 6 1987
8:29:41
PLOT NO. 27
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=21396
MN=-19813
-15235
-10656
-6077
-1498
3AA1

FIGURE 28

TORQUE



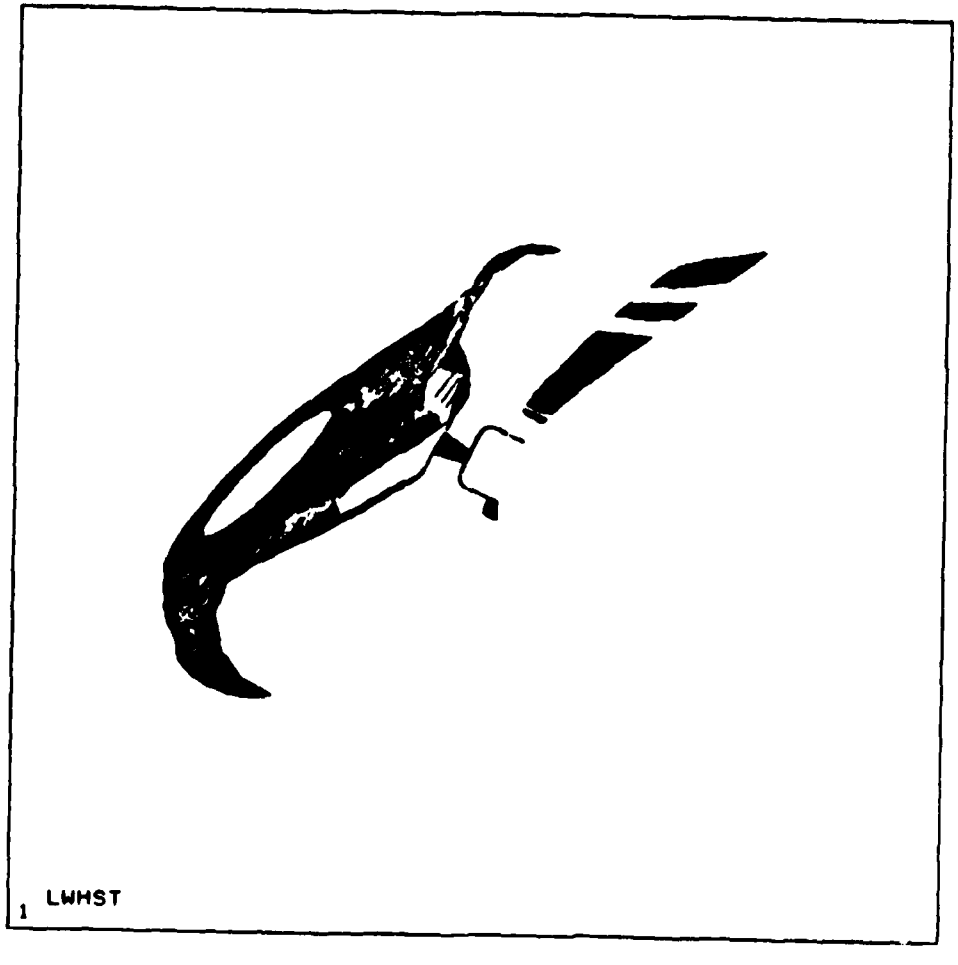
ANSYS 4.2B
FEB 6 1987
8:29:55
PLOT NO. 28
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=39133
MN=-33113
-25088
-17060
-9032
-1004
7024

31108
39136

FIGURE 29

TORQUE



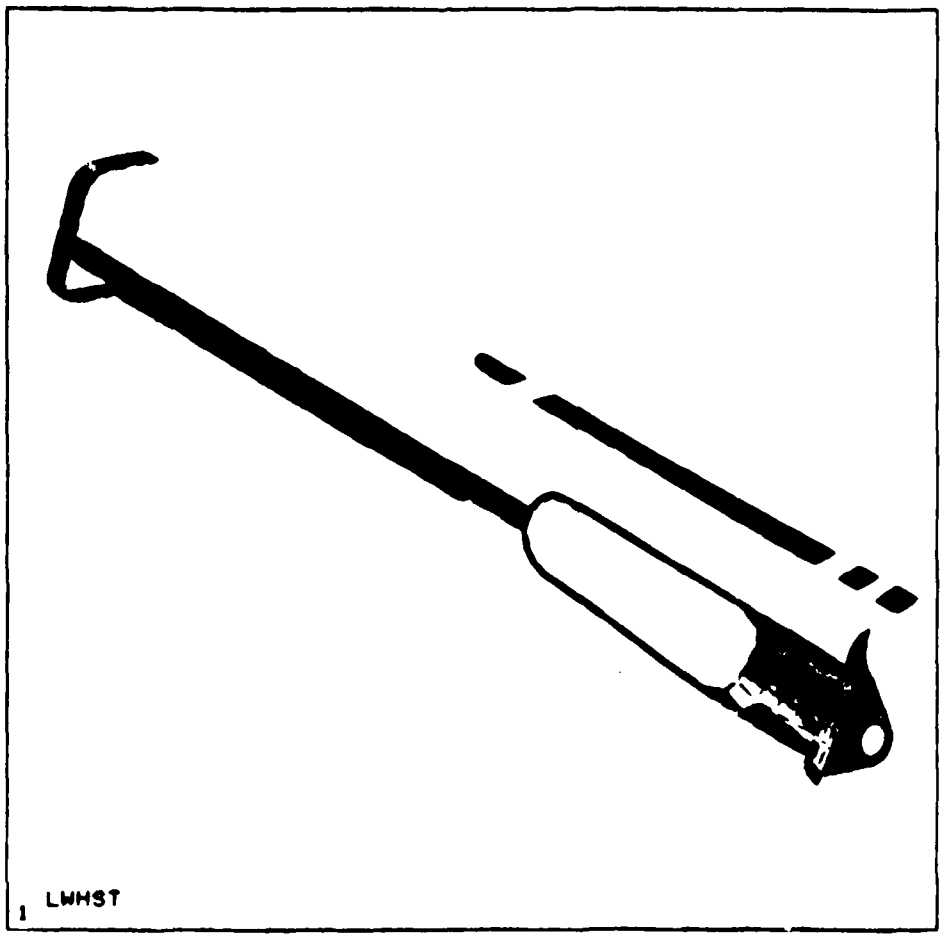
ANSYS 4.2B
FEB 6 1987
8:30:10
PLOT NO. 29
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=21396
MN=-19813
-15235
-10656
-6077
-1498
3081

16818
21397

FIGURE 30

TORQUE

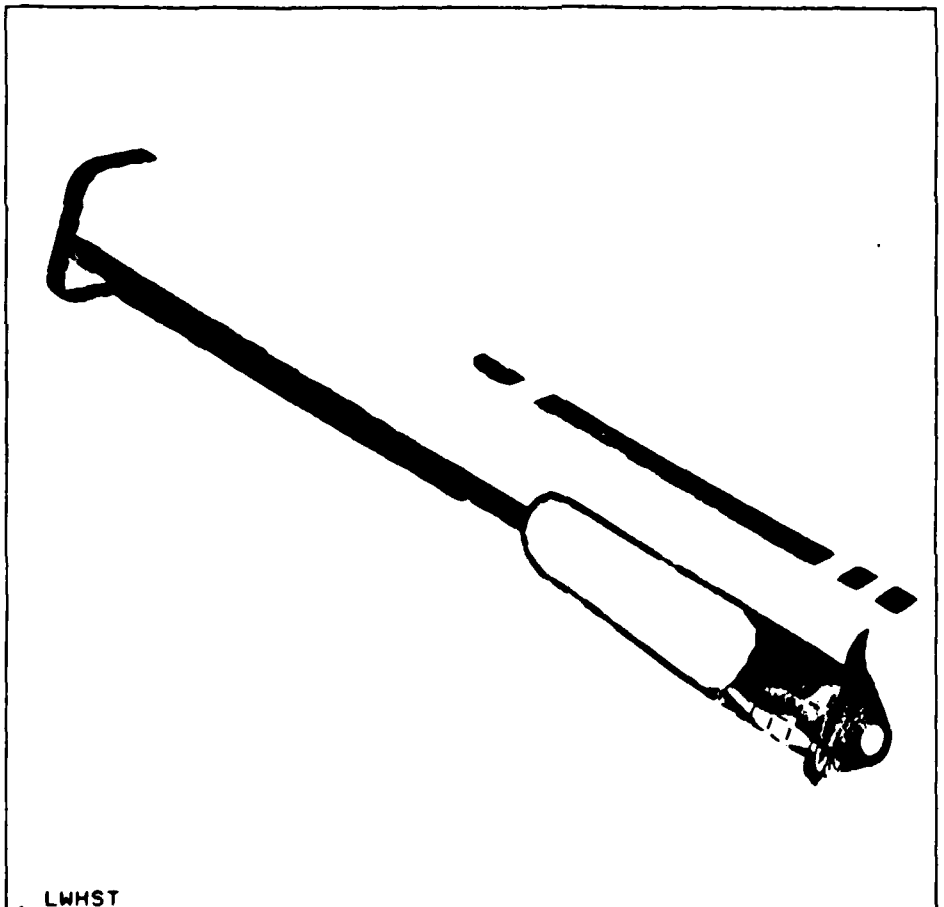


ANSYS 4.2B
FEB 6 1987
8:30:35
PLOT NO. 30
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=32979
MN=-37258
-29457
-21652
-13847
-6042
1763

FIGURE 31

TORQUE

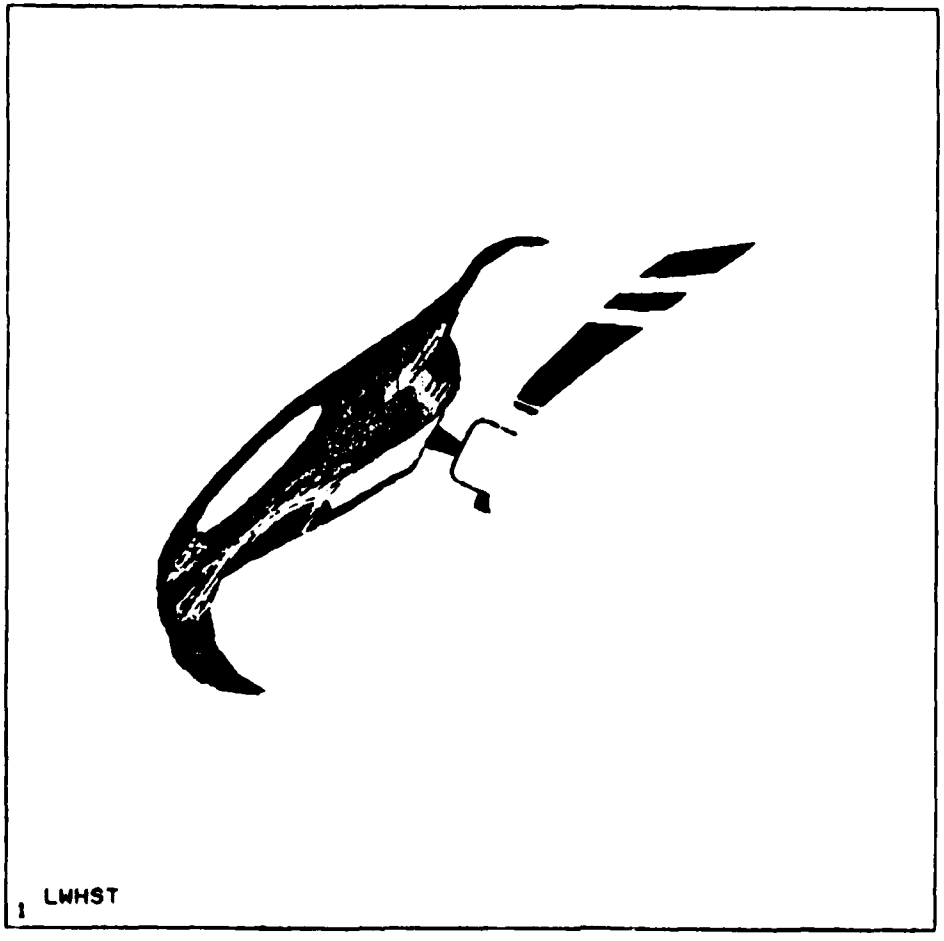


ANSYS 4.2B
FEB 6 1987
8:30:48
PLOT NO. 31
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=18212
MN=-20428
-16137
-11843
-7549
-3255
1039

FIGURE 32

TORQUE



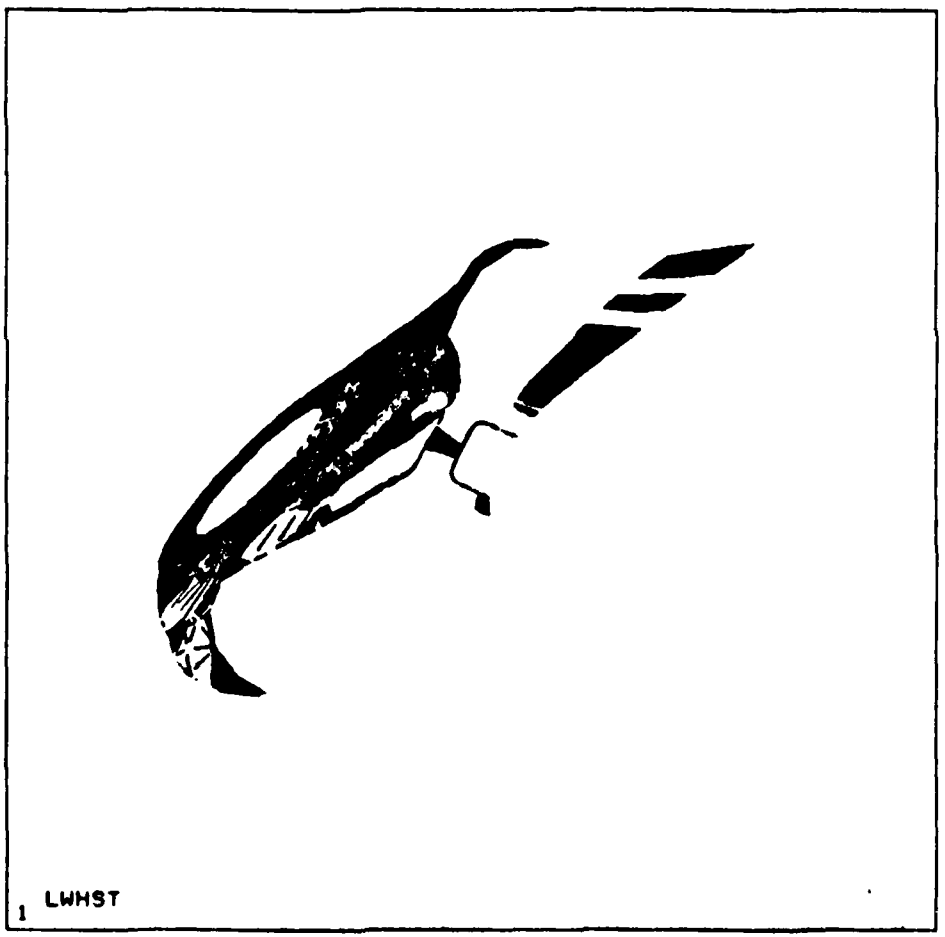
ANSYS 4.2B
FEB 6 1987
8:31:03
PLOT NO. 32
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=32979
MN=-37258
-29457
-21652
-13847
-6042
1763

25178
32983

FIGURE 33

TORQUE



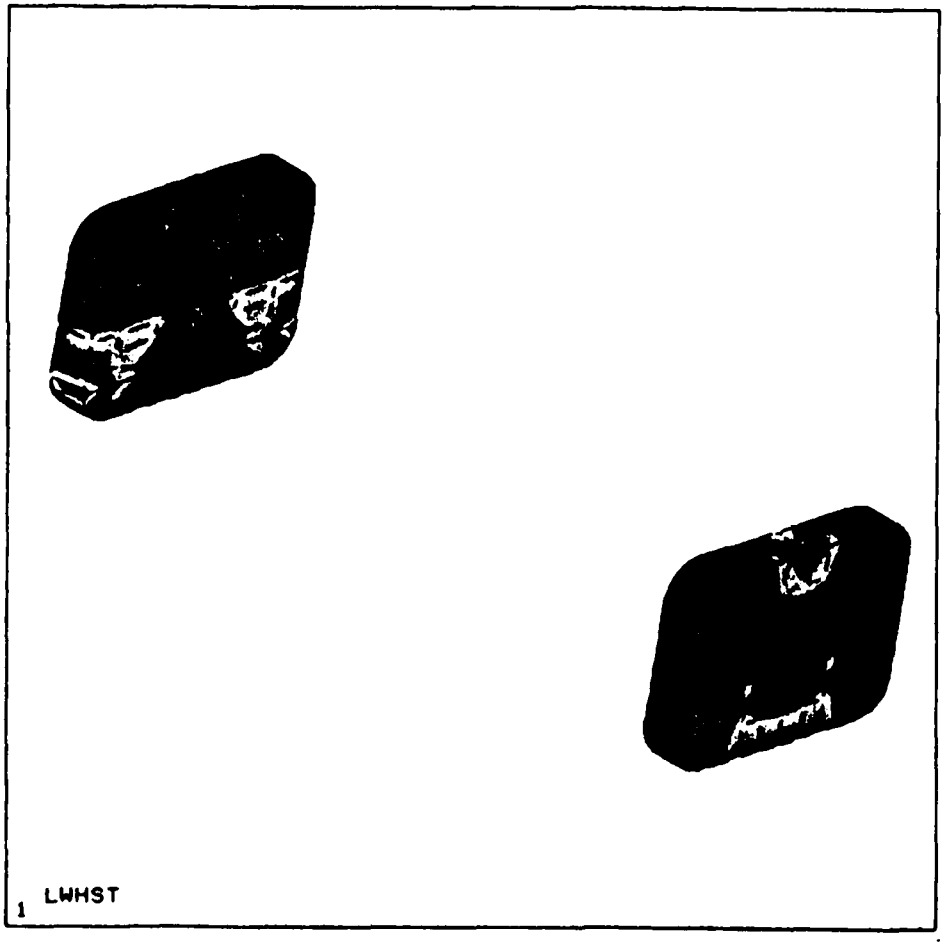
ANSYS 4.2B
FEB 6 1987
8:31:17
PLOT NO. 33
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=18212
MN=-20428
-16137
-11843
-7549
-3255
1039

13921
18215

FIGURE 34

TORQUE



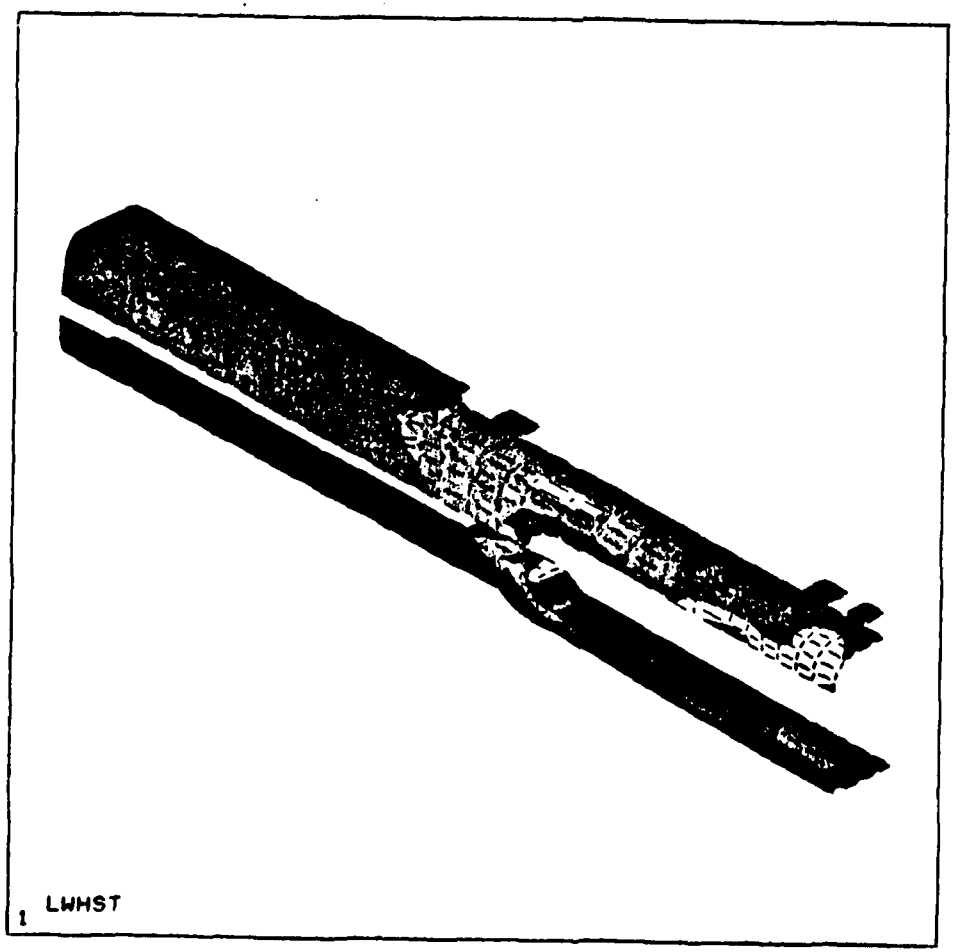
ANSYS 4.2B
FEB 6 1987
8:31:57
PLOT NO. 34
POST1 STRESS
STEP=2
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=1393
MN=20.2
171
324
477
630
783

1242
1395

FIGURE 35

COMBINED

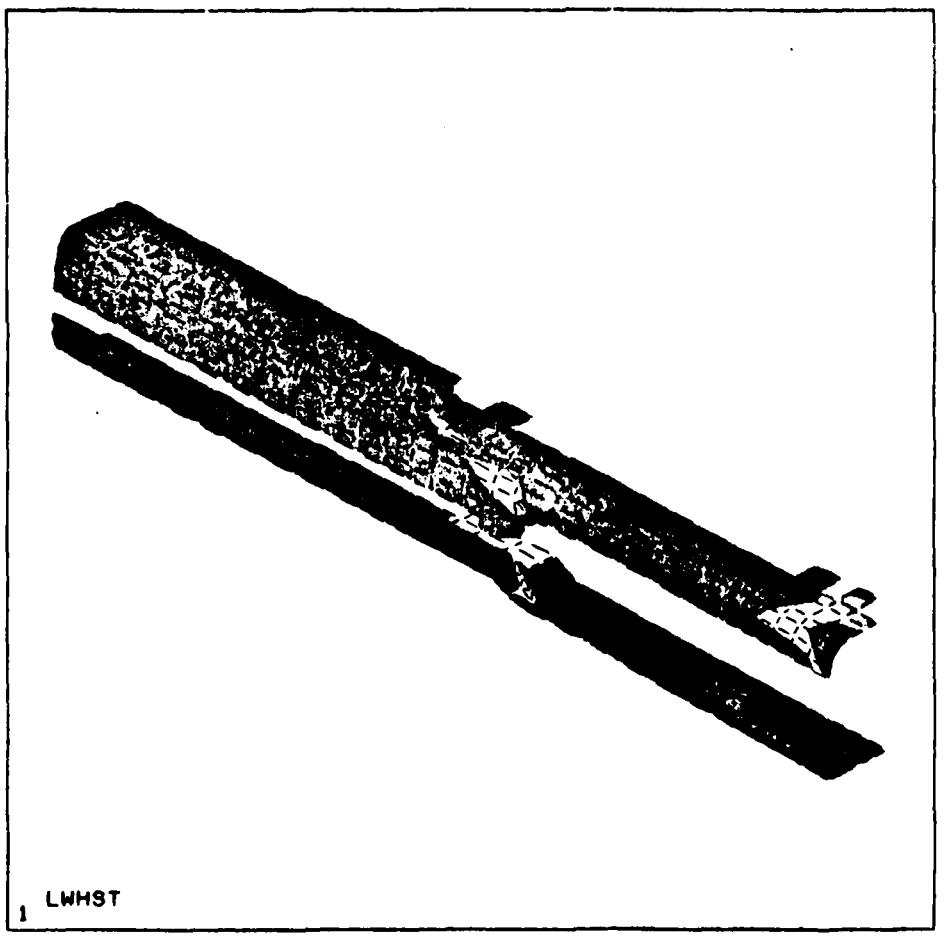


ANSYS 4.2B
FEB 6 1987
8:34:24
PLOT NO. 35
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=14787
MN=-27590
-22883
-18174
-13465
-8756
-4047

FIGURE 36

COMBINED

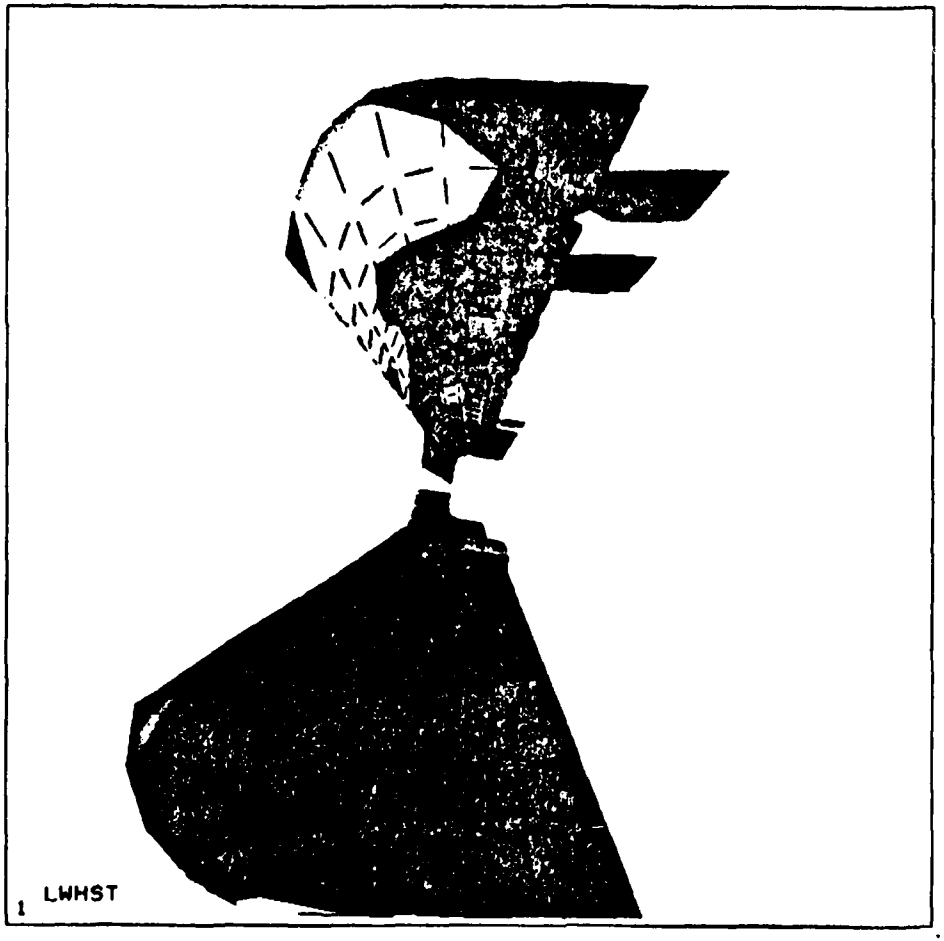


ANSYS 4.2B
FEB 6 1987
8:34:54
PLOT NO. 36
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=24030
MN=-34396
-27905
-21413
-14921
-8429
-1937

FIGURE 37

COMBINED



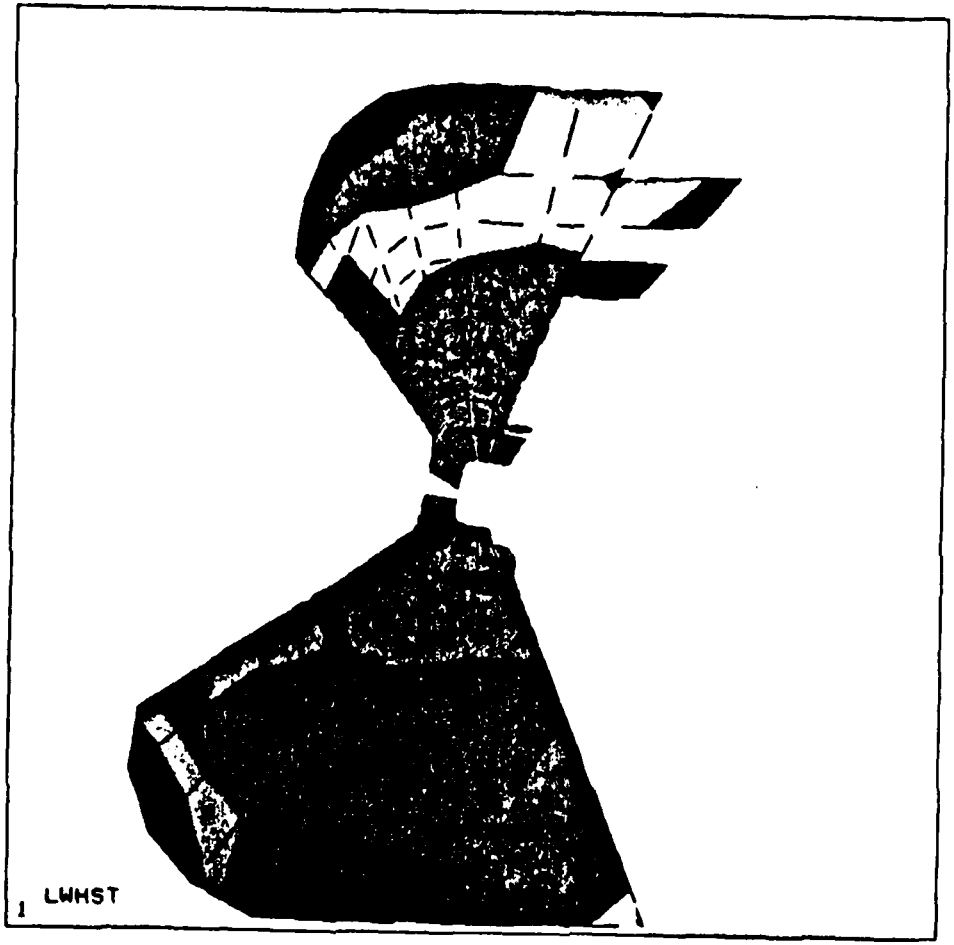
ANSYS 4.2B
FEB 6 1987
8:35:17
PLOT NO. 37
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=14787
MN=-27590
-22883
-18174
-13465
-8756
-4047

10080
14789

FIGURE 38

COMBINED



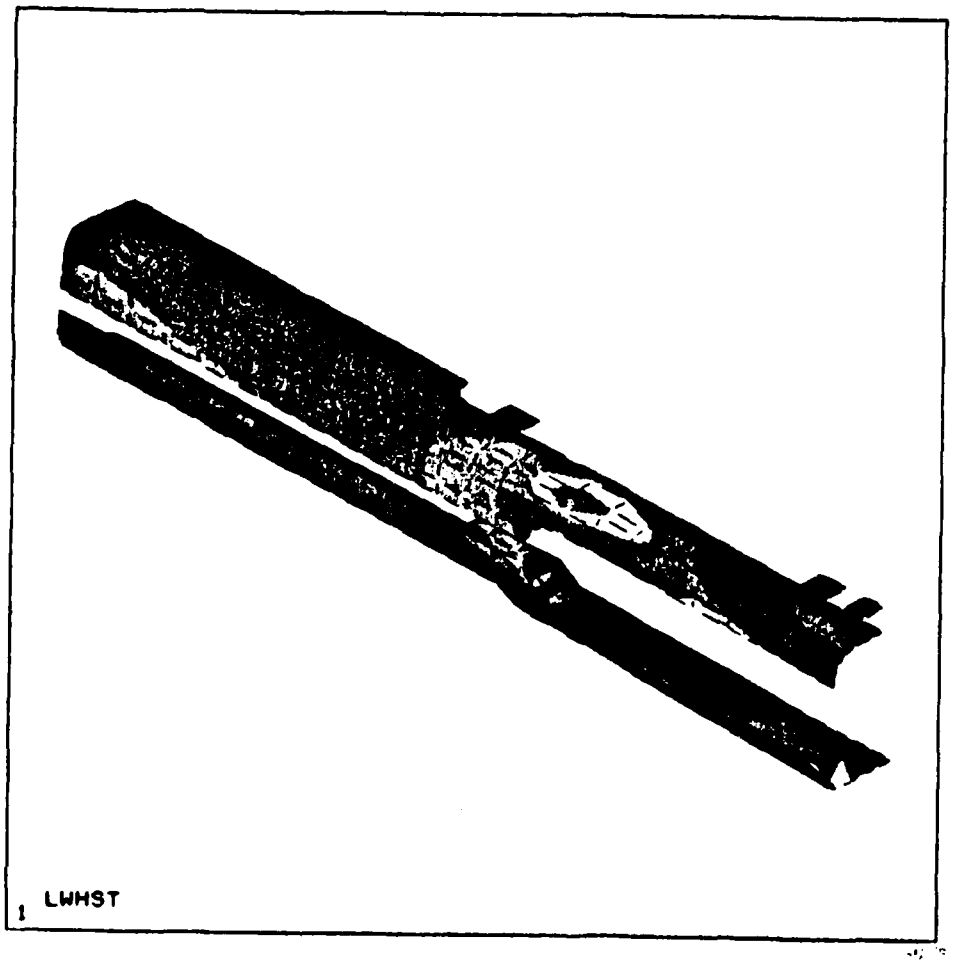
ANSYS 4.2B
FEB 6 1987
8:35:44
PLOT NO. 38
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=24030
MN=-34396
-27905
-21413
-14921
-8429
-1937

17539
24031

FIGURE 39

COMBINED

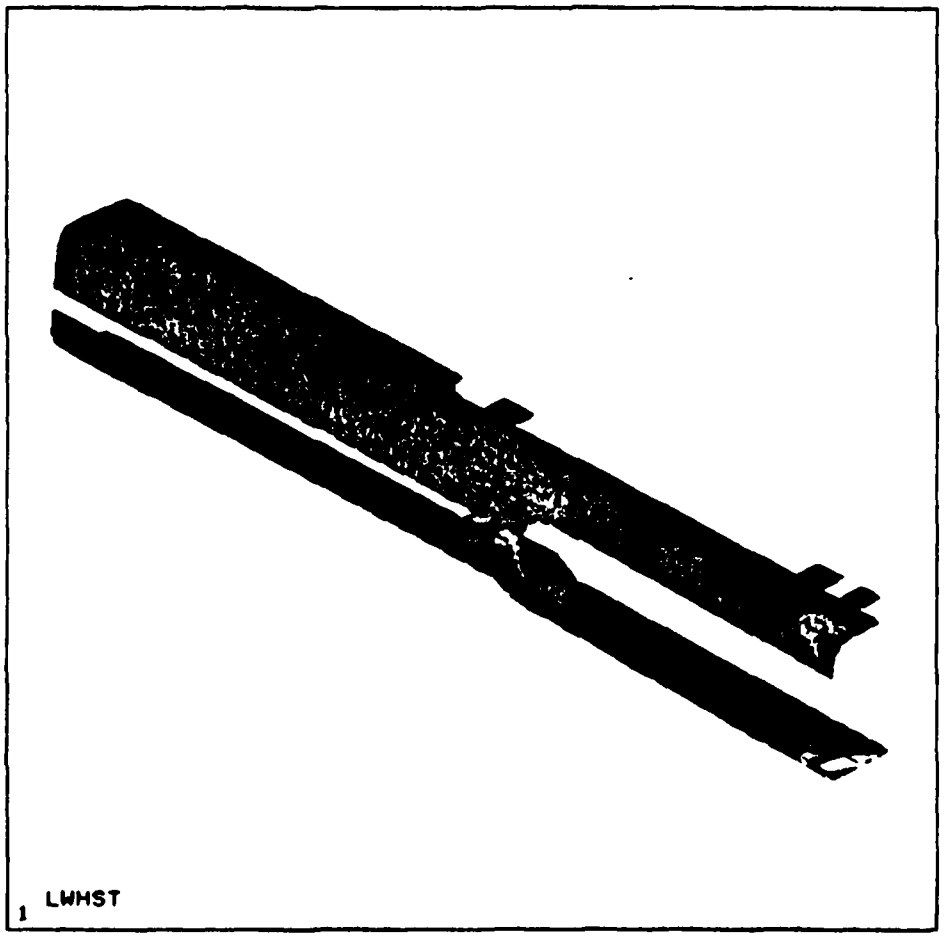


ANSYS 4.2B
FEB 6 1987
8:36:22
PLOT NO. 39
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=11448
MN=-19668
-16213
-12755
-9297
-5839
-2381

FIGURE 40

COMBINED

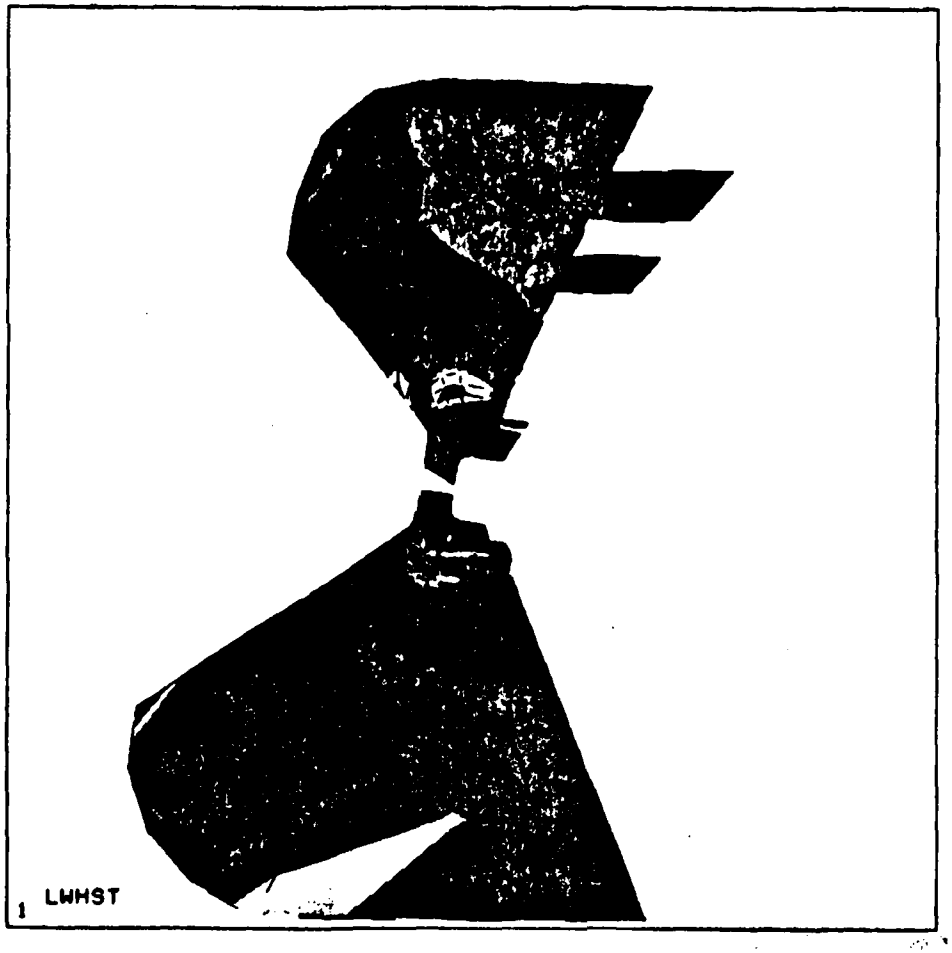


ANSYS 4.2B
FEB 6 1987
8:36:45
PLOT NO. 40
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.74
YF=1.45
ZF=-112
HIDDEN
MX=18720
MN=-18352
-14236
-10116
-5996
-1876
2244

FIGURE 41

COMBINED



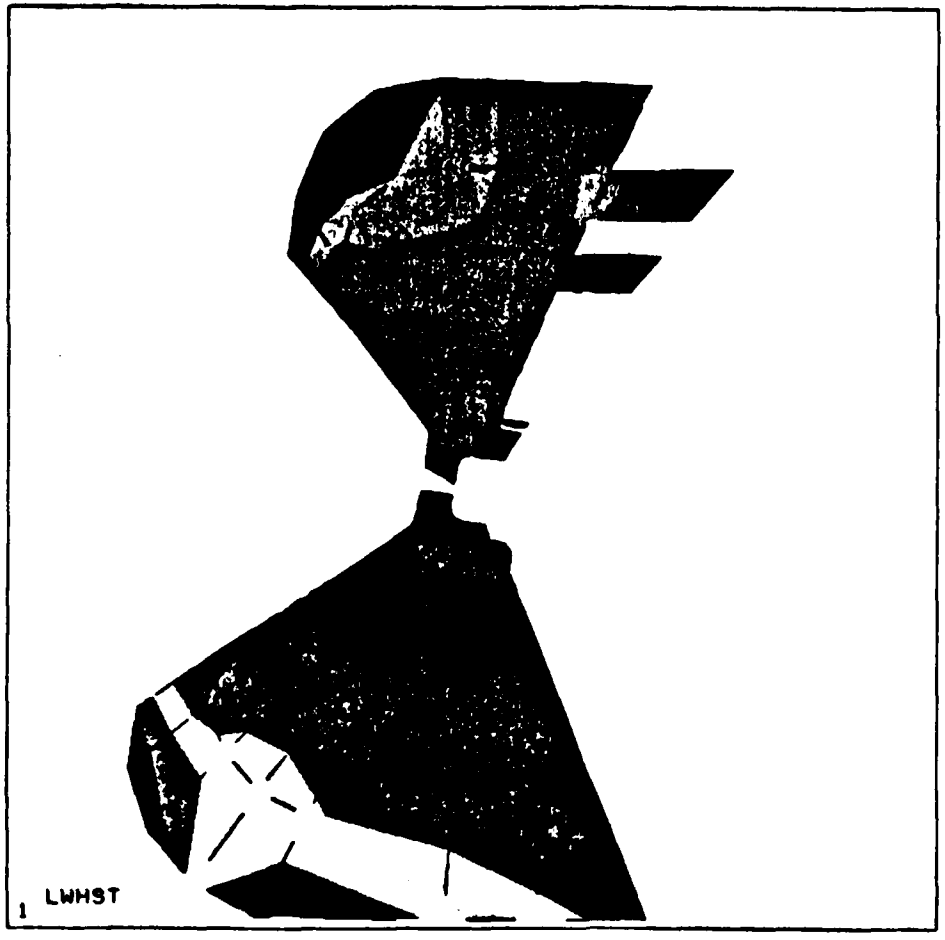
ANSYS 4.2B
FEB 6 1987
8:37:11
PLOT NO. 41
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=11448
MN=-19668
-16213
-12755
-9297
-5839
-2381

7993
11451

FIGURE 42

COMBINED



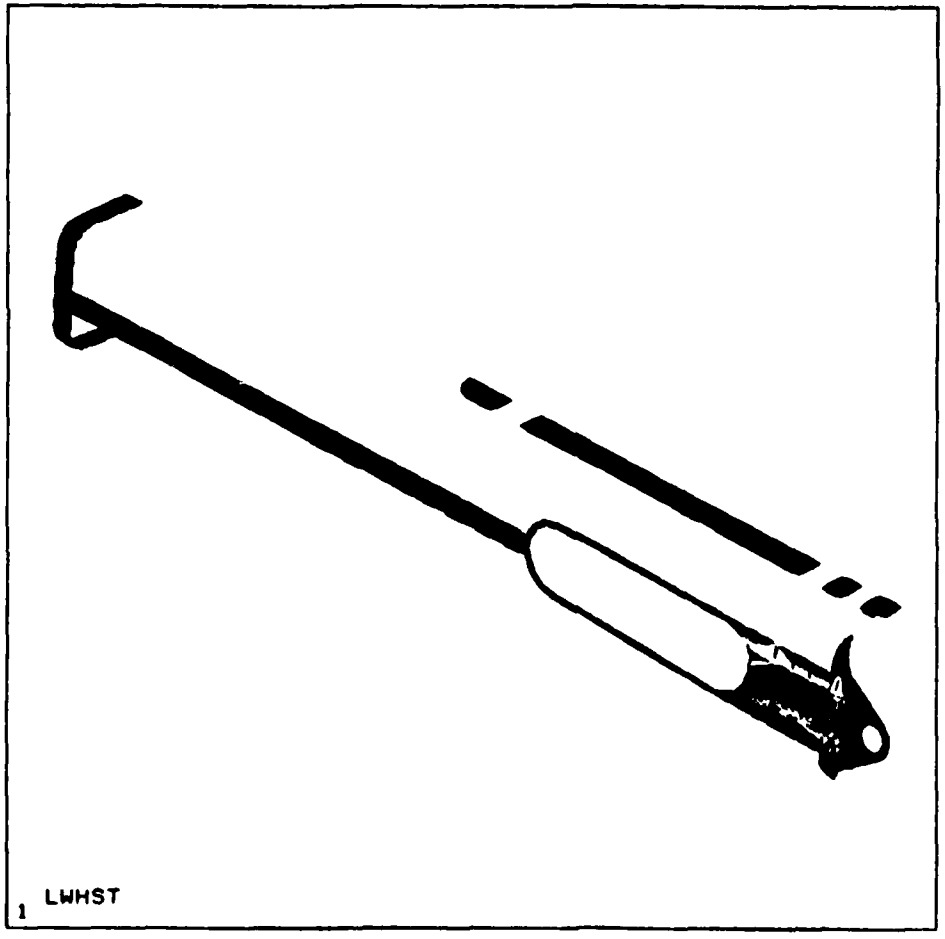
ANSYS 4.2B
FEB 6 1987
8:37:38
PLOT NO. 42
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=18720
MN=-18352
-14236
-10116
-5996
-1876
2244

14604
18724

FIGURE 43

COMBINED

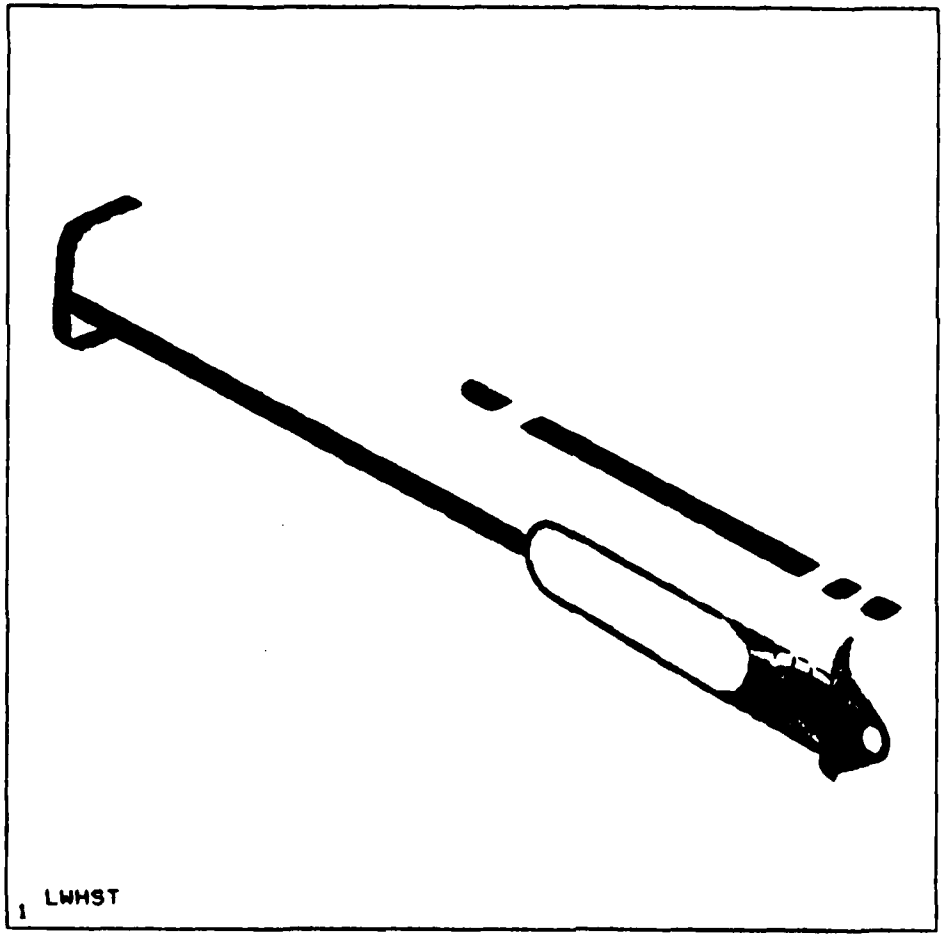


ANSYS 4.2B
FEB 6 1987
8:38:24
PLOT NO. 43
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=38401
MN=-33385
-25411
-17434
-9457
-1480
6497

FIGURE 44

COMBINED

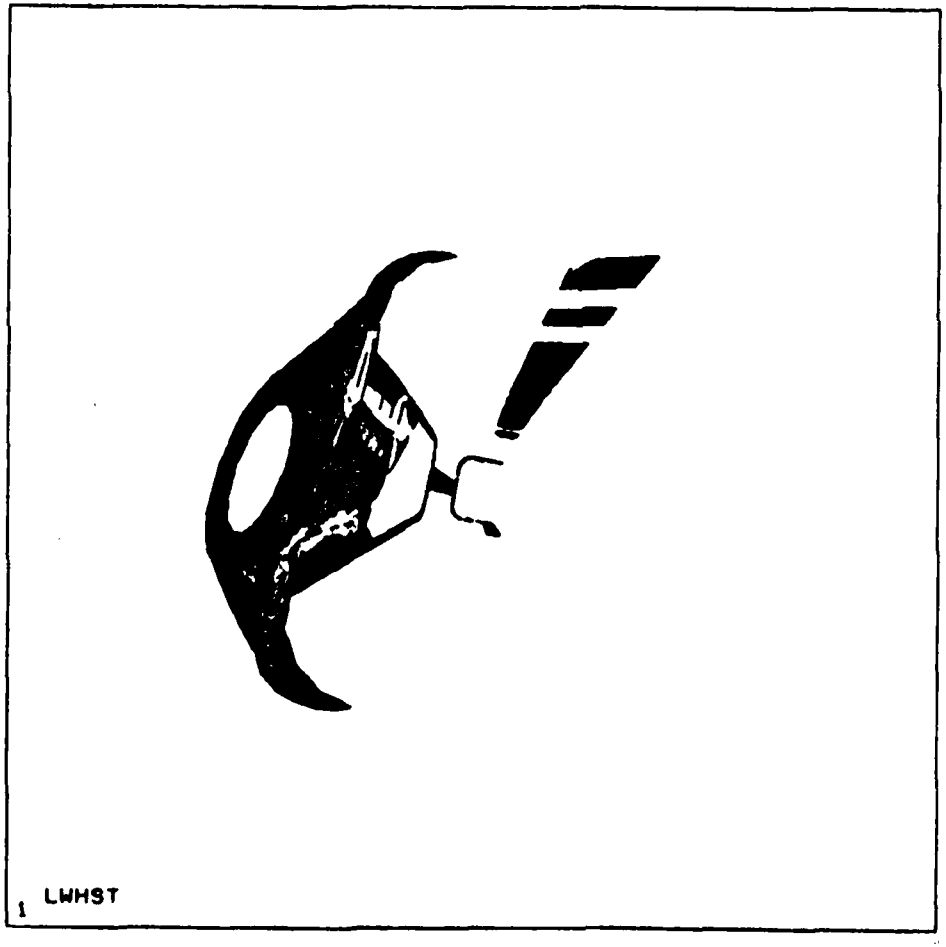


ANSYS 4.2B
FEB 6 1987
8:38:37
PLOT NO. 44
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=21013
MN=-24667
-19593
-14517
-9441
-4365
711

FIGURE 45

COMBINED



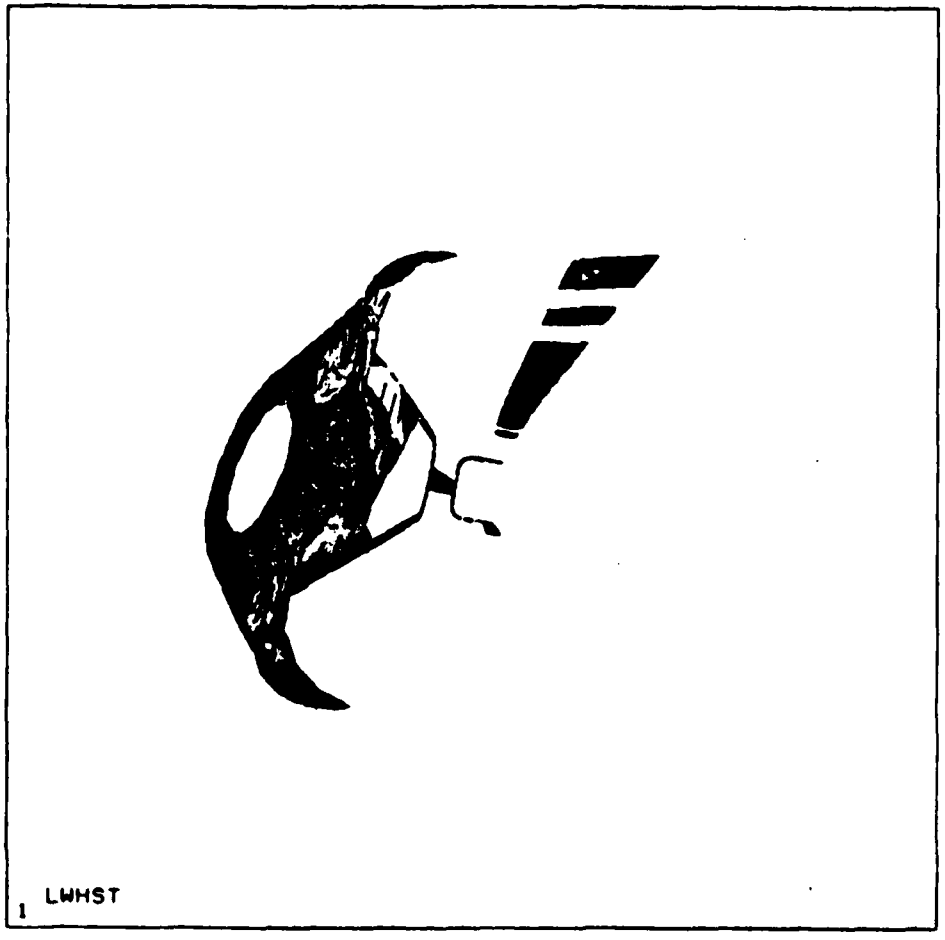
ANSYS 4.2B
FEB 6 1987
8:38:52
PLOT NO. 45
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=30401
MN=-33385
-25411
-17434
-9457
-1480
6497

30428
38405

FIGURE 46

COMBINED



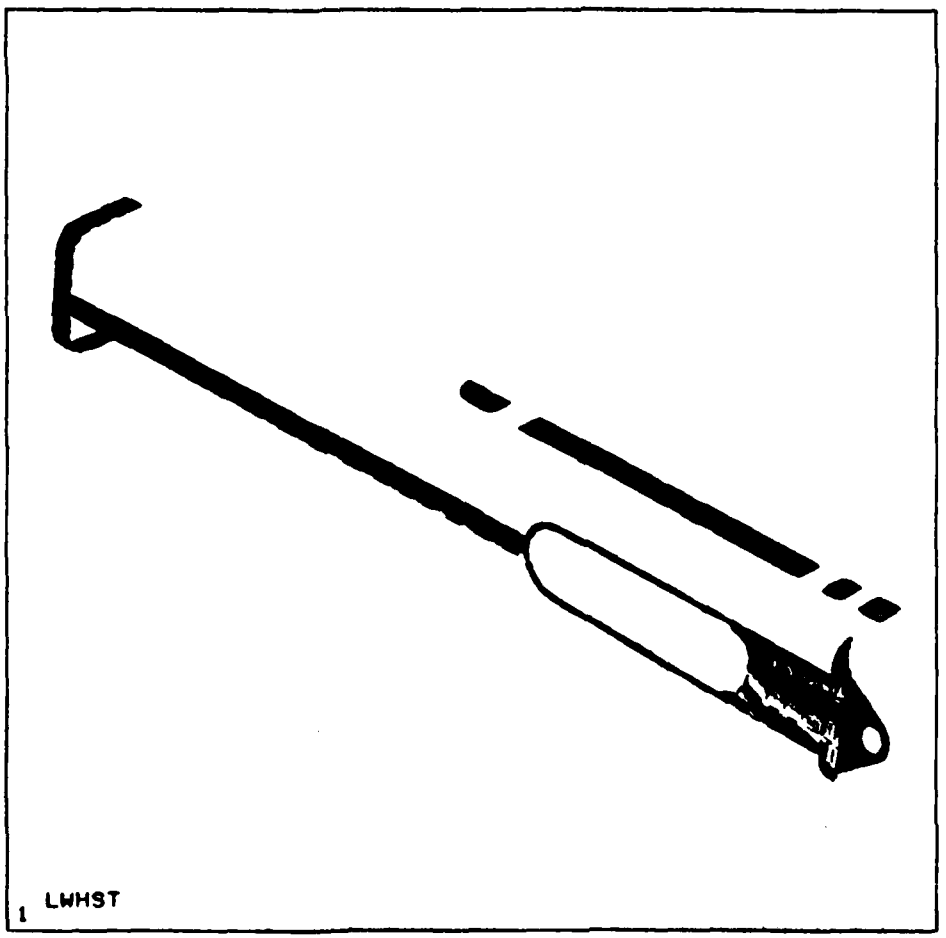
ANSYS 4.2B
FEB 6 1987
8:39:06
PLOT NO. 46
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=21013
MN=-24667
-19593
-14517
-9441
-4365
711

15939
21015

FIGURE 47

COMBINED

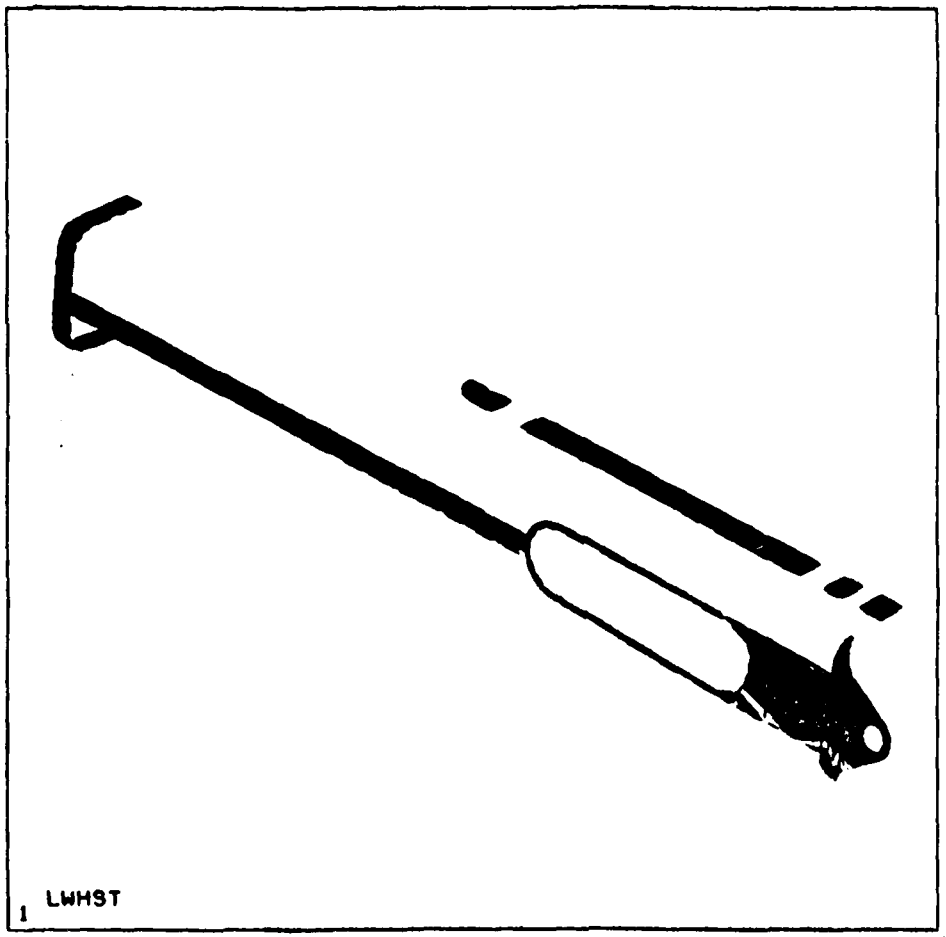


ANSYS 4.2B
FEB 6 1987
8:39:31
PLOT NO. 47
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=32552
MN=-36544
-28869
-21191
-13513
-5835
1843

FIGURE 48

COMBINED

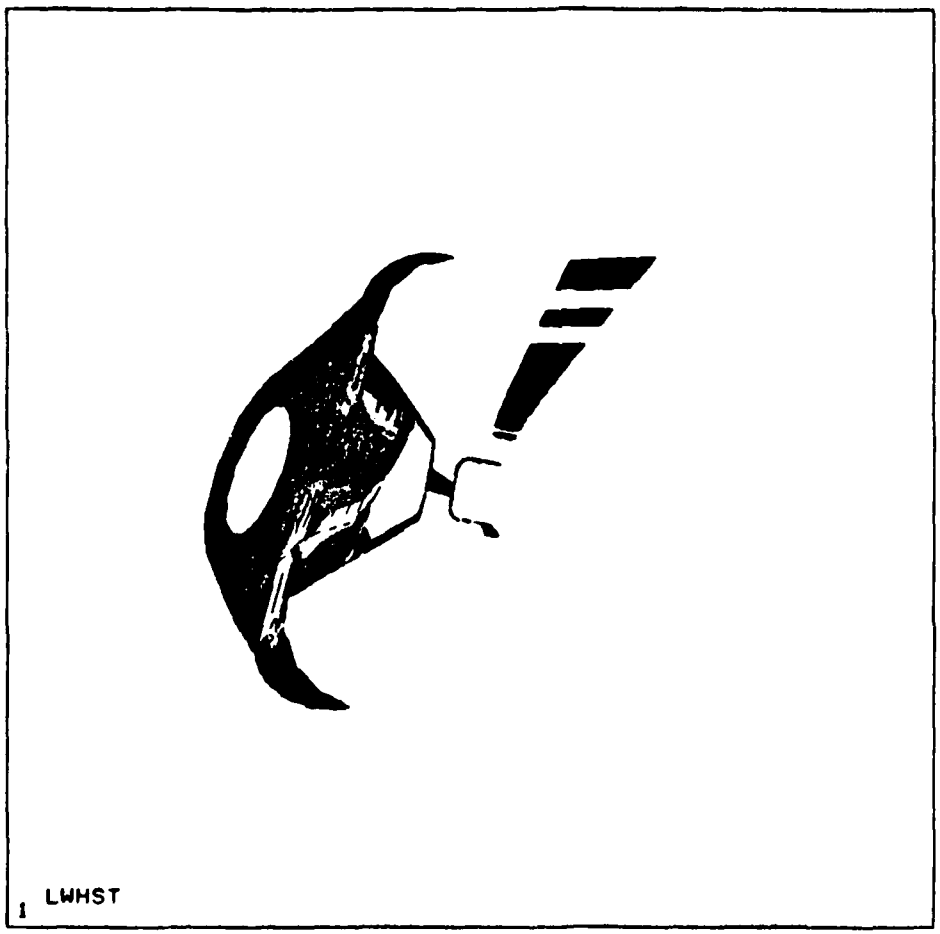


ANSYS 4.2B
FEB 6 1987
8:39:44
PLOT NO. 48
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.8
XF=10.5
YF=1.43
ZF=-111
HIDDEN
MX=16183
MN=-20470
-16399
-12326
-8253
-4180
-107

FIGURE 49

COMBINED



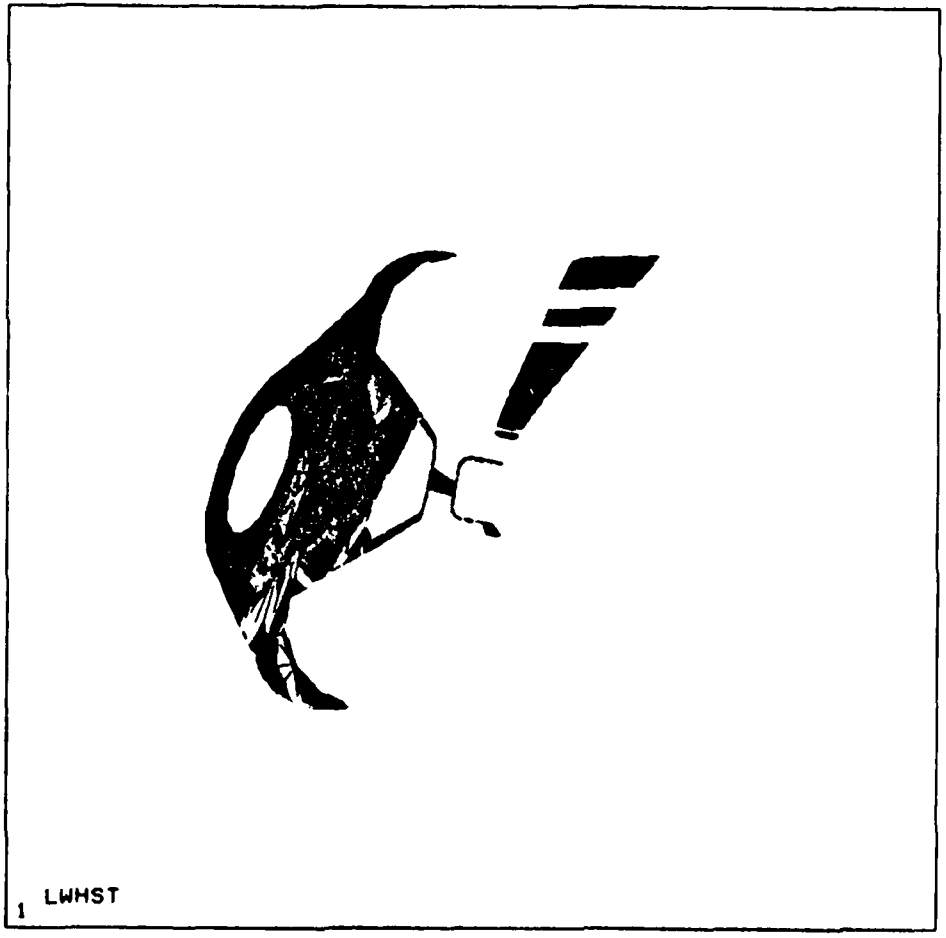
ANSYS 4.2B
FEB 6 1987
8:40:07
PLOT NO. 49
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=32552
MN=-36544
-28869
-21191
-13513
-5835
1843

24877
32555

FIGURE 50

COMBINED



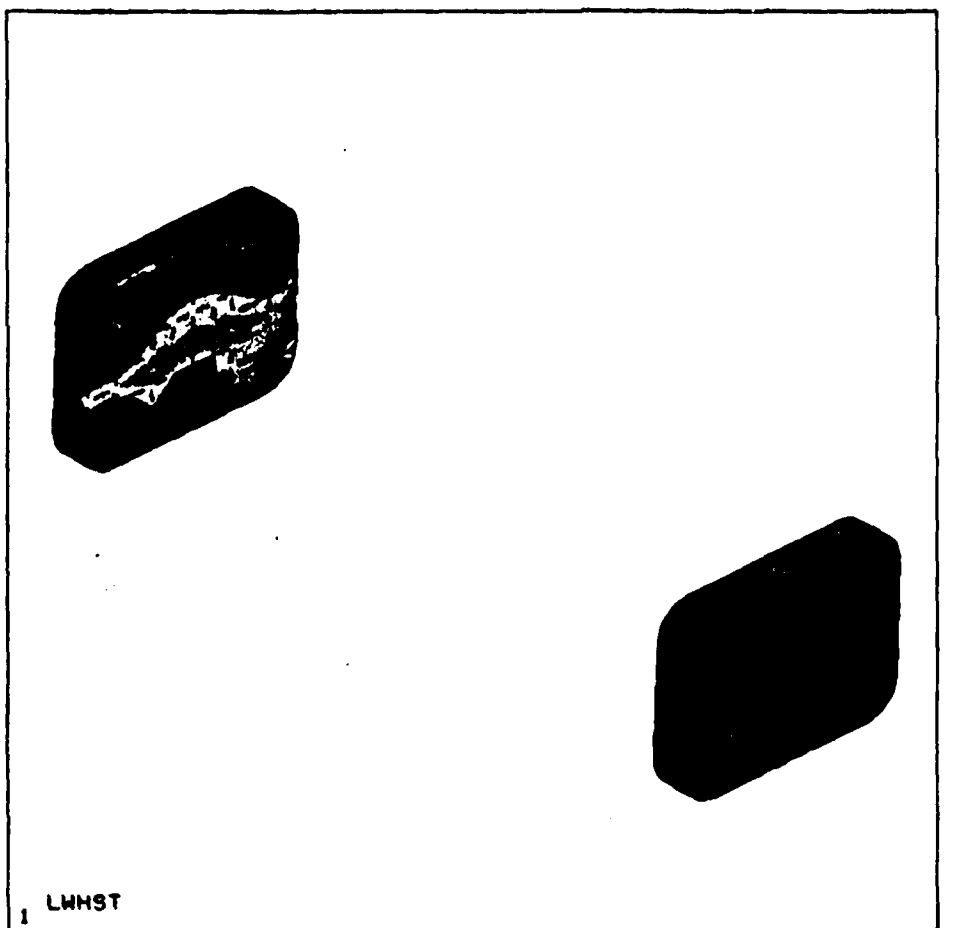
ANSYS 4.2B
FEB 6 1987
8:40:20
PLOT NO. 50
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=16183
MN=-20470
-16399
-12326
-8253
-4180
107

12112
16185

FIGURE 51

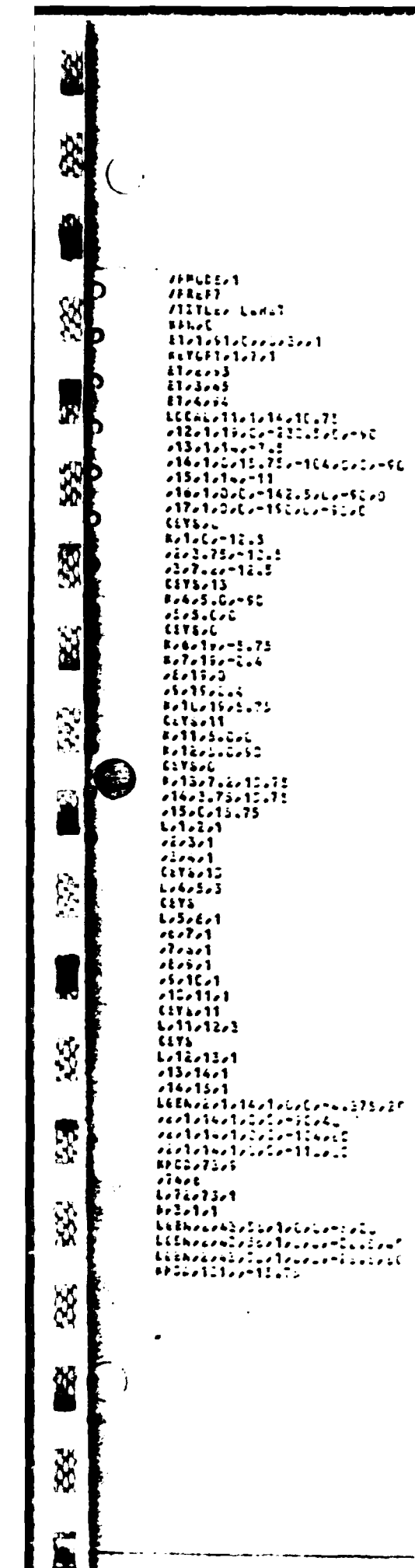
COMBINED



ANSYS 4.2B
FEB 6 1987
8:41:04
PLOT NO. 51
POST1 STRESS
STEP=3
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=3423
MN=25.9
401
779
1157
1535
1913
3047
3425

COMPUTER RESULTS - MODEL 11

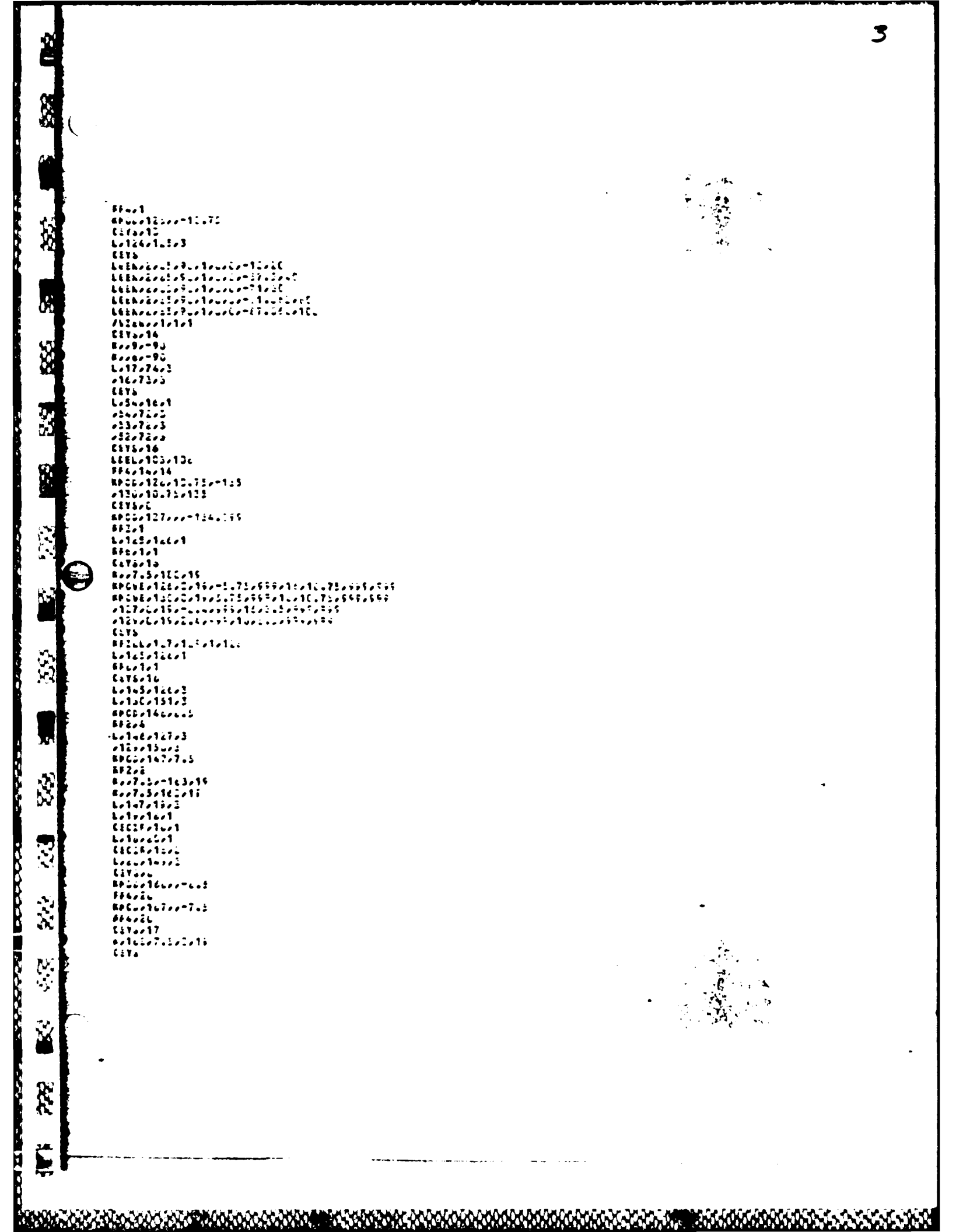


LTHD CRADLE

Model 11

RCVD
LJL
2-9-87

f 2-5 wa



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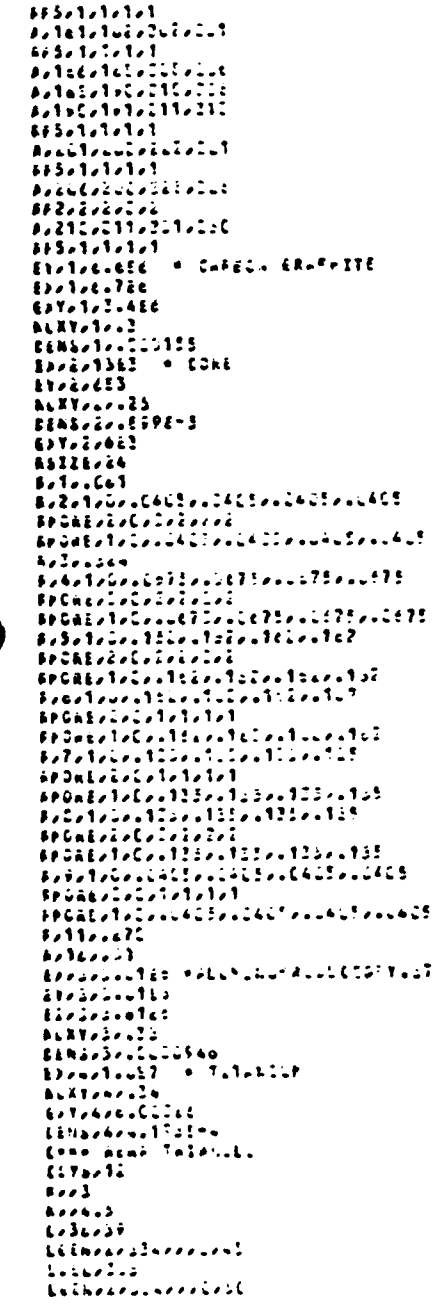
RPC[illegible]
RF4,2[illegible]
RPC[illegible]
RF4,2[illegible]
CSV[illegible],17
L,1[illegible]7,1[illegible]
,1[illegible]
CSV[illegible]
L,1[illegible],1[illegible]7,1
,1[illegible],17[illegible]
L,1[illegible],1[illegible]
,170,19[illegible]
L,1[illegible],20[illegible],2
,19[illegible],1[illegible]
,205,[illegible],1
,21[illegible],11,1
RDE[illegible],1[illegible]7,135,2
RF2,2[illegible],2[illegible]
LDI[illegible],11[illegible]
,12[illegible]
L,1[illegible],1[illegible],2
RF3,2[illegible],2[illegible]
L,1[illegible],19[illegible],2
RF3,2[illegible],2[illegible]
LDE[illegible],1[illegible],1[illegible]
A,1,2,2[illegible],2[illegible]
RF1[illegible],1,1,1,1
A,21,[illegible],4[illegible],41
RF1[illegible],1,1,1,1
A,41,[illegible],[illegible],[illegible]
RF11,1,1,1,1
A,5[illegible],53,72
,53,5[illegible],72
,54,1[illegible],73,7[illegible]
,54,55,1[illegible]
,73,1[illegible],17,7[illegible]
,74,17,75
A,[illegible],[illegible],[illegible]
RF1[illegible],1,1,1,1
A,[illegible],[illegible],1[illegible]
RF1[illegible],1,1,1,1
A,1[illegible],1[illegible],1[illegible],1[illegible]
RF1[illegible],1,1,1,1
A,121,1[illegible],1[illegible],1[illegible]
RF4,1,1,1,1
A,1[illegible],1[illegible],1[illegible]
A,12[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible]
A,1[illegible],1[illegible],1[illegible]
RF4,1,1,1,1
A,141,1[illegible],1[illegible],1[illegible]
RF6,1,1,1,1
A,14[illegible],1[illegible],17[illegible],1[illegible]
RF6,1,1,1,1
A,1[illegible],1[illegible],1[illegible],1[illegible]
RF5,1,1,1,1
A,1[illegible],1[illegible],3[illegible],1[illegible]
A,3[illegible],1[illegible],1[illegible],1[illegible]
A,1[illegible],[illegible],1[illegible],1[illegible]
A,1[illegible],17[illegible],1[illegible],[illegible]
A,17[illegible],171,1[illegible],1[illegible]
```



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LEEN,[illegible]
L,57,[illegible]
,[illegible]
,[illegible]
,[illegible]
K,,[illegible]
L,57,[illegible]
CEC[illegible]
L,[illegible]
CEC[illegible]
L,[illegible]
CEYS
K,,[illegible]
K,,[illegible]
L,231,77
,225,78
,77,[illegible]
,78,60
CEYS,15
L,224,[illegible]
CEYS,11
L,232,77
CEYS
LEIV,363
A,224,[illegible]
A,225,[illegible]
,[illegible]
,[illegible]
,[illegible]
,[illegible]
LEIV,341
,[illegible]
LEIV,[illegible]
,[illegible]
A,[illegible]
A,[illegible]
A,[illegible]
,[illegible]
A,[illegible]
,[illegible]
,[illegible]
,[illegible]
C*** START MESH
KFALL
LEALL
AFALL
PAT,1
TYPE,2
REAL,1
ELSI,10
CEYS
APESH,1,14
,15
,[illegible]
,[illegible]
,[illegible]
REAL,2
TYPE,1
APESH,17,[illegible]
,[illegible]
,[illegible]
,[illegible]
REAL,3
TYPE,2
APESH,[illegible]
,[illegible]
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,63,81
,54,57
,109,110
,121,124
,129
,133,136
,141
,147,146
,153
REAL,4
TYPE,1
APESH,46,50
,55,57
,60,64
,69,71
,74,78
,83,85
,88,92
,99,101
,104,107
,112,113
REAL,5
TYPE,1
APESH,51
,54
,65
,68
,79
,82
,92
,96
,106,
,111
,120
,125
,128
,134
,137
,140
,146
,149
,152
REAL,7
TYPE,1
APESH,44
,58
,72
,86
,102
,114
REAL,8
TYPE,1
APESH,115,119
,126,127
APESH,130,133
,138,139
,142,145
,150,151
REAL,9
TYPE,1
APESH,16
,20
,23
,30
,34
,37
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REAL,11
TYPE,2
APEX,,,3
,,9
,,12
,,17
,,103
,,115
ELEM,4
REAL,16
TYPE,2
APEX,,134,167
C*** MODIFY TOP ELEMENTS FOR ADDED CORE
TYPE,1
REAL,6
EPOS,246,231,3
,,,3e
TYPE,1
REAL,7
EPOS,,52e,,53E,,4
C*** PARAPETS
RPRS,,1,,13
REEN,,,1,,4,,1,,6,,,CC1
REEN,,,,5,,11,,1,,,CC1
REEN,,,,12,,,15,,1,,6,,,CC1
RGUS,,,1,,15
REEN,,,,11E,,12E,,1,,,4,,5,,,
REEN,,,,,12E,,,,,,,4,,5,,,
REEN,,,,,12E,,,,15E,,1,,,C,,,
REEN,,,,,1E7,,,,1E,,,1,,,3,,,
REEN,,,2,,,E7,,,,1E,,,1,,,E,,7E
CSYS,,13
L,,117,,116,,3
CSYS,,11
L,,136,,14C,,3
CSYS
A,,96,,10,,,,2C7,,,,3e
A,,1CC,,11E,,,,137,,,,2C7
A,,11E,,,,117,,,,13E,,,,1C7
A,,,,2E,,,,2C7,,,,2E,,,,2C7
A,,,,2C7,,,,1C7,,,,1E6,,,,2C6
A,,,,1e7,,,,13E,,,,1CC,,,,1e6
A,,,,136,,,,11C,,,,11E,,,,1eC
A,,,,237,,,,2e7,,,,21e,,,,2cc
A,,,,2e6,,,,1e6,,,,15e,,,,21e
A,,,,1e6,,,,1eC,,,,17e,,,,19e
A,,,,1eC,,,,116,,,,1cC,,,,17E
A,,,,23E,,,,21e,,,,217,,,,2e6
A,,,,21e,,,,1e6,,,,1e7,,,,217
A,,,,1ec,,,,17e,,,,177,,,,1e7
A,,,,17e,,,,1eC,,,,13e,,,,177
A,,,,23e,,,,217,,,,21E,,,,24C
A,,,,217,,,,1e7,,,,16E,,,,211
A,,,,167,,,,177,,,,17E,,,,16F
A,,,,177,,,,1cE,,,,1e7,,,,17E
A,,,,2eC,,,,21E,,,,216,,,,2e1
A,,,,21E,,,,1e,,,,1e7,,,,21E
A,,,,1eE,,,,17E,,,,17E,,,,1e6
A,,,,17E,,,,1e7,,,,13E,,,,176
A,,,,2e1,,,,21F,,,,2eC,,,,2E
A,,,,21E,,,,1e6,,,,2eC,,,,2eC
A,,,,16E,,,,17E,,,,1eC,,,,2eC
A,,,,17E,,,,1eC,,,,1eE,,,,2E
A,,,,2e2,,,,2eC,,,,13E,,,,15E
A,,,,2eC,,,,,,,,13E,,,,1e7
A,,,,2eC,,,,1eC,,,,1eC,,,,13E
```

```
C*** TRIANGULAR AREAS
A,117,118,135
A,135,140,140
A,243,0,0,6
L,235,243
VCRAG,168,169,170,171,172,173,437
VCRAG,174,175,176,177,178,179,437
VCRAG,180,181,182,183,184,185,437
VCRAG,186,187,188,189,190,191,437
VCRAG,192,193,194,195,196,197,437
VCRAG,198,,,,,,,437
RP2,1
APENCE
PAT,3
TYPE,3
REAL,1
ELSI,,1
VPESH,1,30
VPESH,31,32
ERSE,TYPE,3
NELEP
NGEN,2,500,ALL,,,0,0,-110
EGEN,2,500,ALL
EALL
NALL
C*** NECCIL CYLINDERE
ET,5,16
TYPE,5
PAT,5
REAL,21
R,21,5.[illegible],.456
E,2090,2089
,2089,2590
,2590,2589
E,2030,2028
,2028,2530
,2530,2528
PAT,8
EA,6,2[illegible]
GENS,6,0
E,2020,2037
,2037,2049
,2049,2059
,2059,2069
,2069,2079
,2079,2089
,2054,2053
,2053,2057
,2057,2059
,2054,2058
,2058,2055
,2055,2056
,2058,2060
,2030,2036
,2036,2050
,2050,2060
,2060,2070
,2070,2080
,2080,2090
EGEN,2,500,-19
C*** NEFLECT
NALL
EALL
CSYS,0
SYMP,1,[illegible]
SYMP,1,[illegible]
```

```
PERUS
C*** CANNON BARREL
TYPE,5
REAL,22
R,22,9.075,1.0075
MAT,5
EX,5,29E6
NLXY,5,.3
DENS,5,.0007301
N,10001,0,0,100.76
N,10002,0,0,0
N,10003,0,0,0
,10005,0,0,-104
FILL
N,10006,0,0,-110
E,10001,10002
EGEN,5,1,-1
C*** CABLES
N,10007,19,35,-244
,10009,19,-7.5,0
FILL
N,10010,-19,35,-244
N,10012,-19,-7.5
FILL
ET,6,4
TYPE,6
MAT,6
EX,6,20E6
NLXY,6,.3
DENS,6,.0013
REAL,26
R,26,2.2,.4,.4,1.5,1.5
E,10007,10008
,10006,10009
EGEN,2,3,-2
D,10007,LX,0,,10010,5,UY,UZ,ROTY
C*** WEAR PIVOT
CEYS,12
N,10013,0,0,0
N,10014,0,0,-36
CEYS
R,23,.001,.001,.001
REAL,23
ET,7,21
TYPE,7
E,10013
E,10014
CEYS,0
CERI,10013,1215
,10013,1622
RF10,0,1
CERI,10013,1667
,10013,1273
RF9,0,1
CERI,10013,1512
RF8,0,1
CERI,10013,1945
RF4,0,1
CERI,10013,1967
RF4,0,1
CERI,10013,1996
RF5,0,1
CERI,10014,4515
,10014,4822
RF10,0,1
CERI,10014,4[illegible]7
```

```
,1CC1,,,E73
FF9,C,1
CER1,1Cu1,,,513
FF6,C,1
CeR1,1Ju1,,,6,5
FF6,C,1
CER1,1Cu14,,,5E7
FF6,C,1
CER1,1Cu1,,,554
FF5,C,1
E,1CC13,LA,C,,,1CC14,1,LY,LZ
C,,,, eXTRA PA,S
TYPE,7
R,2,,5.759,5.759,5.759,,,
```

```
,21C,,Y,53C3,3F24
C*** SMALL TC CHILES
CF,,C1,LA,1,1CCC5,,EC35
,,2,,LA,,3C1,,1CC1,,3C35
CFL,,221,,Y,,L2
AF2,,1
C*** MASTER CCP'S
P,,2C57,,UA,,2CC5,,1,,Y,,L2
P,,2D57,,UA,,2EE5,,1,,Y,,L2
P,,3C57,,UA,,3CC5,,1,,Y,,L2
P,,3557,,UY,,3555,1,,Y,,L2
P,,1QCC1,,LA,,1CC05,1,,LY,,L2
PEE,,1D,,C1,,,2
TOTAL,,1CC,,1
ITEA,,1,,1
FAST,,-1,,3,,7
AFF,,2
AEC,,1
B,,1QCC1,,L2,,C
C*** STATIC FIRING FORCE
F,,2C56,,FZ,,-,,CCC,,,,5C5E,,3CCC
F,,2C57,,FY,,C,,,,2C55,,1
F,,2D57,,FY,,C,,,,2E55,,1
F,,3C57,,FY,,C,,,,3C5C,,1
F,,3557,,FY,,-,,,,3555,,1
ACEL,,C,,,,CCC1,,C
LORI
F,,2C56,,FZ,,-,,,,3CE5,,,,3CCC
F,,2C57,,FY,,1C5C,,,,,CC55,,1  * ,,C,,C FT-LF AT 1 RIDE, AT PAE"
F,,2557,,FY,,1C5C,,,,,CC55,,1
F,,3C57,,FY,,-1C3C,,,,,3C5E,,1
F,,3557,,FY,,-1C3C,,,,,3CCC,,1
ALEE,,1
LORI
F,,2C56,,FZ,,-,,CCC,,,,5C5E,,,,CCC
F,,2C57,,FY,,1C5C,,,,,CC55,,1
F,,2557,,FY,,1C5C,,,,,2EE5,,1
F,,3C57,,FY,,-1C3C,,,,,3C5C,,1
F,,3557,,FY,,-1C3C,,,,,3CCC,,1
ACEL,,C,,,,3,,,,,2
LORI
SAVE
AFOR
FINI
/INP,,67
FINI
/EOF
/EOF
/FR,,F,,
RIA,,,,4
RET&F,,,,3CC
FILL,,1,,1,,3CC,,1,,,,CC1,,,,CC1
FILL,,2,,1,,23,,1,,2,,-,,3C3E,,3E3,,
FILL,,,,,,23,,,,23C,,1,,-,,CCCC,,,,11,,,,2
FILL,,,,2,,25C,,,,27,,1,,-,,53C,,,,2,,,,1,,,,
CCP,,,,,,
```

```
C*** FY,1516,2
C*** FY,4916,4
C*** FY,1,13,2
C*** FY,4913,4
C*** FY,2C6*,2
C*** FY,5C*4,4
C*** FY,2Co1,2
C*** FY,5C*1,4
LFWR,1,SCC
FINI
/EXEC
/INP,27
/INP,23
FINI
/EOF
```

COMPUTER RESULTS - MODEL 11

```
**********  ANSYS INPUT DATA LISTING (FILE19)  **********

/CORE,,,2000000
/PMODE,2
/POST1
STRESS,FAX,4,1
*SET,I,1,1
*BEGIN,*NC
SET,I,1
NREE,,10001,10012
PRGI
EPSE,STIF,4
PRST
EALL
*END
*DO,PAC,1,2
FINI
/EOF

***** MEMORY REQUEST FROM /CORE *****
 MAXIMUM FIXED  =        0
 MAXIMUM TEMP   =        0
 MAXIMUM VIRTUAL= 2000000

***** MEMORY OBTAINED *****
 FIXED  =  640000
 TEMP   =        0
 VIRTUAL= 2000000

PLOTS PUT ON FILE33 FOR PLOT33 (RASTER MODE)
```

LTHD CRADLE
Model 11

RCVD
LJL
2-9-87

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 -      (MCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK RODAMAKER    PHONE (403) 736-1636    TWX

/POST1                                                                  9.5500  FEB  6,1987 CP=      2.276

        ***** ANSYS RESULTS INTERPRETATION (POST1) *****

STORE FAX   FOR ELEMENT TYPE STIF  4  FROM STEP     1

PARAMETER= 1        1.000       1.000       0.

BEGIN MACRO MAC

USE LOAD STEP     1  ITERATION     1  SECTION   1  FOR LOAD CASE     1


*** NOTE ***  PILOT2 CONTAINS STIF91 ELEMENTS.
     MID STRESSES ARE NOT AVAILABLE FOR THESE ELEMENTS.
     SELECT TOP OR BOTTOM STRESSES.

GEOMETRY STORED FOR  10214  NODES   1618  ELEMENTS
 TITLE=  LWHST

DISPLACEMENT STORED FOR10214 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1516 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1618 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     1  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 4266  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

```
        ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B        (PCR)              JUN 1,1985
    (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL MARK KOJANAKER     PHONE (412) 746-3304    TWX

 LdnST                                                                  9.0C75  FEB  6,1987 CP=     62.642

        ***** POST1 NODAL DISPLACEMENT LISTING *****

 LOAD STEP     1  ITERATION=     1  SECTION=  1
 TIME=  0.             LOAD CASE=  1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES          Recoil

   NODE      UX            UY            UZ            ROTX          ROTY          ROTZ
  10CC1  -0.7886e5c9E-11 -2.8394.5C4    0.          0.7Be9e509E-02 -0.146724C1E-13 -0.8CC57750E-13
  10CC2  -0.1326C502E-11 -1.5966E4E4    0.          0.7869e9C8E-02 -0.146724C1E-13  0.8CC57750E-13
  10CC3  -0.6C415557E-11 -1.5e65254     0.          0.79e539566E-02 -0.14713117E-13  0.8C643711E-13
  10CC4  -0.52E37ec1.-11 -1.1424429     0.          0.78C64225E-02 -0.15C48C7CE-13  0.826043S7E-13
  10CC5  -0.46EC3C1CEE-11 -0.7B3EC7e5   0.          0.7953B9e3E-02 -0.14607171E-13  0.34190933E-13
  10CC6  -0.e4e164e3E-11 -0.e8C55316    0.          0.7959e435E-02 -0.14554252E-13  0.1427718EE-13
  10CC7   0.              0.            0.          0.935079136-02  0.              0.3641e4C1e-04
  10CC8   0.773E4E52E-03 -0.77e79E10    -0.13e75622   0.635079691E-02  0.16940E59E-19  0.3641e4C1E-04
  10CC9   0.1547e5716-02 -1.5e65616     -0.2e691239   0.635079e8E-02  0.23716923E-19  0.3641e4C1E-04
  10C10   0.              0.            0.          0.675C7913E-02  0.             -0.3641e4C1E-04
  10C11  -0.773346E5E-03 -0.77e79E1C    -0.13e75622   0.635079691E-02 -0.16940E59E-19 -0.3641e4C1E-04
  10C12  -0.15e7e5716-02 -1.5e75619     -0.2e691238   0.e3507868E-02 -0.23716923E-19 -0.3641e4C1E-04

 MAXIMUMS
 NODE       10C12          10CC1          10C11          10CC1          10004          10C12
 VALUE   -0.1547e5716-02 -0.5396.5C4    -0.2e691229   0.7Be9e65C9E-02 -0.15C48C70E-13 -0.3641e4C1E-04

 BASE  FOR LABELS STEP  FROM     4 TO     4 BY    1

   4  ELEMENTS (OF 1C1E  DEFINED) SELECTED BY  BASE  COMMAND.

 POINT ELEMENT STRESS STEPS PER ELEMENT
```

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B        (PCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK ROCAMAKER    PHONE (406) 736-1636    TWX
LWHST                                                                    9.6086  FEB  6,1987 CP=    64.761

        ***** POST1 ELEMENT STRESS LISTING *****

 LOAD STEP     1  ITERATION=     1  SECTION=  1
 TIME=   C.                LOAD CASE=  1

 ELEM        FAX
 1610    0.69280755
 1611    0.69280816
 1612    0.69280755
 1613    0.69280816

 1618  ELEMENTS (OF 1618  DEFINED) SELECTED BY  EALL  COMMAND.

 END PACRO

 EXECUTE PACRO MAC    2 TIMES WITH MULTIPLIER FROM    1 TO    2 IN STEPS OF  1

 USE LOAD STEP     2  ITERATION     1  SECTION    1  FOR LOAD CASE     1

 DISPLACEMENT STORED FOR10014 NODES

 STRESSES STORED FOR    1  SELECTED ITEMS

 NODAL STRESSES AND TEMPS. STORED FOR 1516 ELEMENTS

 ITERATION SUMMARY INFORMATION STORED

 NODAL FORCES STORED FOR 1618 ELEMENTS

 REACTIONS STORED FOR   15 REACTIONS

 FOR LOAD STEP=     2  ITERATION=     1  SECTION=   1
  TIME=  C.              LOAD CASE=  1
  TITLE=  LWHST

 NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

   12  NODES (OF 4268  DEFINED) SELECTED BY  NRIE  COMMAND.

 PRINT NODAL DISPLACEMENTS
```

5

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.2 B (MCR) JUN 1,1985
(C) SWANSON ANALYSIS SYSTEMS, INC. HOUSTON, PENNSYLVANIA 15342
FOR SUPPORT CALL MARK RODAMAKER PHONE (406) 726-1636 TWX

LUNST 9.6322 FEB 6,1987 CP= 97.532

***** POST1 NODAL DISPLACEMENT LISTING *****

LOAD STEP 2 ITERATION= 1 SECTION= 1
TIME= 0. LOAD CASE= 1

torque

THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
10001	-0.81034112	-0.75529733E-06	0.	0.23945177E-08	-0.31948454E-02	0.41800056E-01
10002	-0.42772644	-0.47120679E-06	0.	0.23019605E-08	-0.31948454E-02	0.41800056E-01
10003	-0.40812144	-0.45737156E-06	0.	0.22824130E-08	-0.31571105E-02	0.41788877E-01
10004	-0.25630813	-0.34219900E-06	0.	0.21988500E-08	-0.27978725E-02	0.41728631E-01
10005	-0.10754395	-0.22626522E-06	0.	0.22678955E-08	-0.30282981E-02	0.41668386E-01
10006	-0.85142265E-01	-0.21259020E-06	0.	0.22728675E-08	-0.30586014E-02	0.41661078E-01
10007	0.	0.	0.	-0.31984171E-02	0.	-0.22084476E-02
10008	-0.46529512E-01	0.39602382	0.34570917E-01	-0.31984193E-02	-0.97578196E-18	-0.22084476E-02
10009	-0.93859024E-01	0.79204799	0.69111892E-01	-0.31984216E-02	-0.13178830E-17	-0.22084476E-02
10010	0.	0.	0.	0.31984253E-02	0.	-0.22084476E-02
10011	-0.46529512E-01	-0.39602462	-0.34571024E-01	0.31984230E-02	-0.97578196E-18	-0.22084476E-02
10012	-0.93859023E-01	-0.79204890	-0.69111969E-01	0.31984208E-02	-0.14094628E-17	-0.22084476E-02

→ 2.39°

MAXIMUMS

NODE	10001	10012	10013	10010	10002	10001
VALUE	-0.81034112	-0.79204890	-0.69111969E-01	0.31984253E-02	-0.31948454E-02	0.41800056E-01

ERSE FOR LABEL= STIF FROM 4 TO 4 BY 1

4 ELEMENTS (OF 1618 DEFINED) SELECTED BY ERSE COMMAND.

PRINT ELEMENT STRESS ITEMS PER ELEMENT

6

```
        ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.0 7        (CC)          JUN 1,1975
    (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL MARK NOGALAKIS    PHONE (402) 720-9630    TWX

LWNST                                                                    9.6331  FEB  6,1957 CP=     99.199

        ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP     2  ITERATION=     1  SECTION=  1
TIME=   0.                 LOAD CASE=  1

ELEM        PAX
1610     12044.266
1611     12044.266
1612    -1 044.277
1613    -1  44.277

1616  ELEMENTS (OF 1613  DEFINED) SELECTED BY  CALL  COMMAND.

USE LOAD STEP     2  ITERATION     1  SECTION    1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR 1014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1515 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1515 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP     2  ITERATION=     1  SECTION=   1
 TIME=  0.                 LOAD CASE=  1
 TITLE=  LWNST

NASE  FOR LABEL= NODE  FROM 1001 TO 1014  Y     1

  16  NODES (OF 4202  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

[redacted] (PCF) JUN 1,1979
[redacted] PENNSYLVANIA 15946
FOR SUPPORT CALL PARK ROOM [redacted]

LOAD1

9.6500 FEB 8,1987 CPU 129.677

***** POST1 MODAL DISPLACEMENT LISTING *****

LOAD STEP = 1 SUBSTRUCTURE = 1 SECTION = 1
TIME= 0.0 LOAD CASE= 1

Torque, recoil, 1G

THE FOLLOWING MODAL DISPLACEMENTS ARE IN MODAL COORDINATES

MODE	GX	GY	GZ	ROTX	ROTY	ROTZ
10001	[redacted]	[redacted]	0.	0.171215196E-01	-0.315434546-02	0.419000546-01
10002	[redacted]	[redacted]	0.	0.167647766-01	-0.315434546-02	0.419000546-01
10003	[redacted]	[redacted]	0.	0.166924506-01	-0.315711056-02	0.417986776-01
10004	[redacted]	[redacted]	0.	0.163026446-01	-0.276746256-02	0.417236316-01
10005	[redacted]	[redacted]	0.	0.145107046-01	-0.306226166-02	0.416686366-01
10006	[redacted]	[redacted]	0.	0.141416196-01	-0.306876146-02	0.416516076-01
10007	0.	0.	0.	0.196166236-01	0.	-0.221217526-02
10008	[redacted]	[redacted]	[redacted]	0.103036696-01	-0.101646266-17	-0.221217526-02
10009	[redacted]	[redacted]	[redacted]	0.166677466-02	-0.142456256-17	-0.221217526-02
10010	0.	0.	0.	0.253154656-01	0.	-0.227647606-02
10011	[redacted]	[redacted]	[redacted]	0.167005416-01	-0.976781966-18	-0.227647606-02
10012	[redacted]	[redacted]	[redacted]	0.108561726-02	-0.159768506-17	-0.227647606-02

PARTICIPATION

MODE	10001	10001	10001	10010	10002	10001
VALUE	[redacted]	[redacted]	[redacted]	0.253154656-01	-0.319434546-02	0.419000546-01

BASE FOR LABELS TYP FRQ 0.70 0.49 1

4 ELEMENTS FOR TYPE ORIGINALLY SELECTED BY BASE COMMAND.

PRINT ELEMENT STRESS ITEMS FOR ELEMENT

8

```
        ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 *      (PCF)          JUN 1,1983
    (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL PARK ROWAHAKEA    PHONE (402) 736-1636    TWX

LWMST                                                                    9.6531  FAB  6/1967 CP=    131.340

        ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP      3  ITERATION=      1  SECTION=  1
TIME=   0.                LOAD CASE=  1

ELEM        FAX
1610     -9075.1327
1611     -9075.7743
1612     -33166.676
1613     -33164.327

1616  ELEMENTS (OF 1613  DEFINED) SELECTED BY  CALL  COMMAND.

***** ROUTINE COMPLETED *****  CP =       131.390

PROP ENCOUNTERED ON FILTER

***** RUN COMPLETED *****  CP=      131.5000   TIME=    9.6539
```

D2/280

MCR MEMO: FEBRUARY 11, 1987

MCR
ASSOCIATES, INC.

111 W. Evelyn Ave., Suite 301
Sunnyvale, California 94086
(408) 736-1636

February 11, 1987

Larry Libhardt
FMC Corporation
3989 Central Ave NE
Minneapolis, Minn 55421

Dear Larry,

Here are the results of the latest dynamics model. Figures 1 to 11 are the similar set of elements and area plots from before so you can determine the real properties. I have included a listing of the input that was used to run the transient analysis. Figure 12 is the recoil pulse in pounds. The recoil force is applied to 2 nodes so the total recoil force was divided by 2. Figure 13 is the torque pulse shown in inch-pounds per node. There are 8 nodes having the applied load and they are located 6 inches from the center-line. The same integration time constant was used for the different runs so I only used half of the torque pulse force values which accounts for the non-smooth nature of Figure 13.

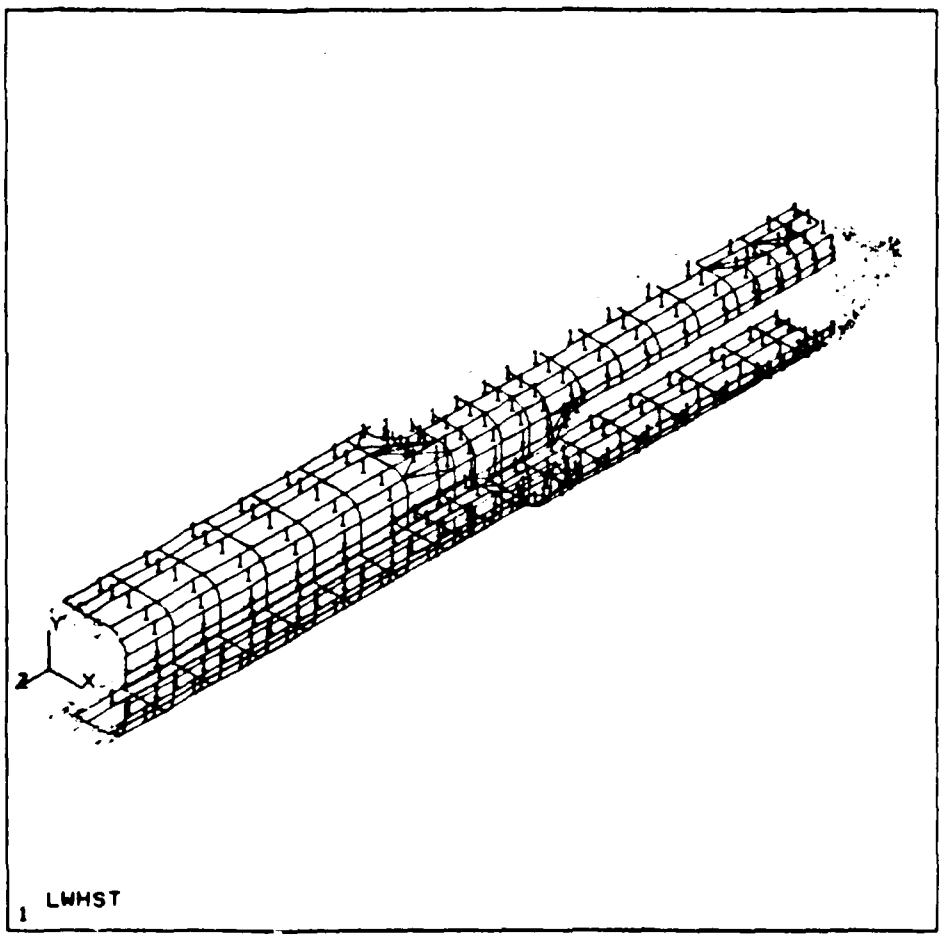
We ran the model first with the recoil force only and then did a restart for the torque case. Figures 14 to 20 are plots of displacement vs. time. Node 1353 is one of the nodes where the recoil load is applied and is located at X=6". Node 4352 is the node of the other side of the manifold in the -X direction. The rear manifold has its node numbers incremented by 500 so node 1853 is at the front surface of the middle manifold. Node 4853 is located at X=6 opposite 1853. The plot labeled ****BEX is the X displacement for the node located at the end of the barrel. The same nodes are plotted vs. time for the torque load case on Figures 21 to 27. It appears that the X displacement of the end of the barrel is much less under the torque load then we experienced before. Let me know if there is any additional work you need done.

Best regards,

Mark C. Rodamaker

Mark C. Rodamaker

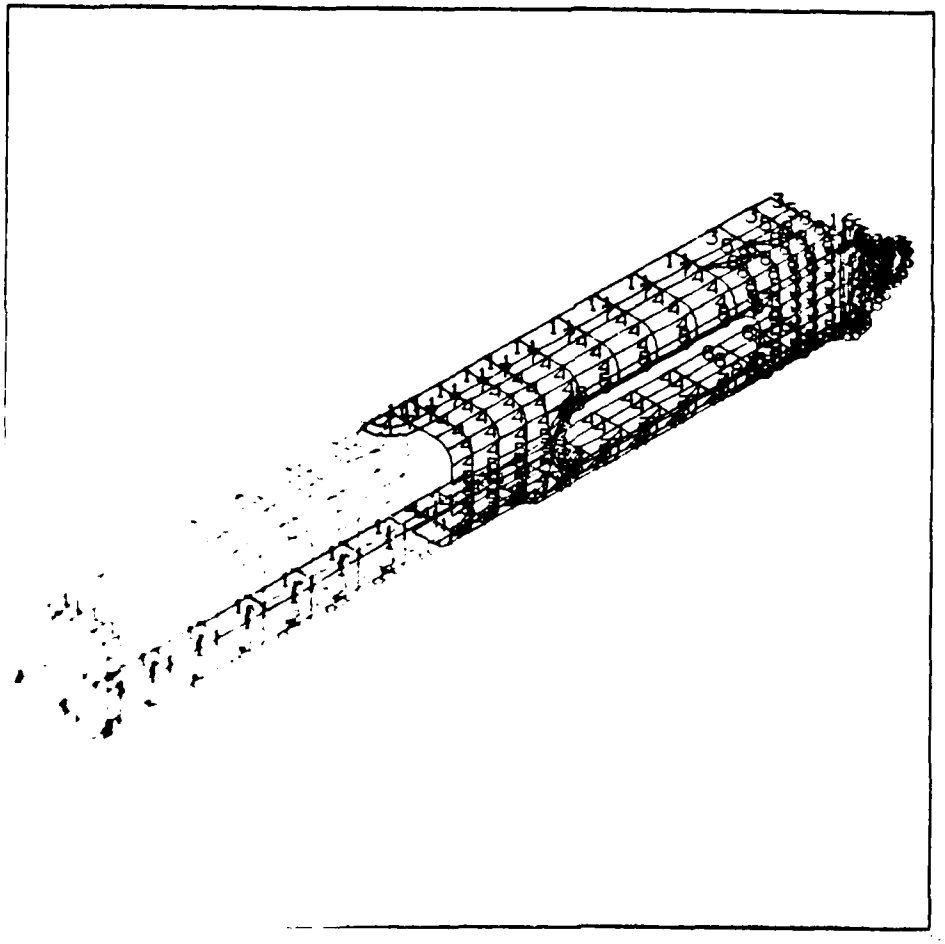
FIGURE 1



ANSYS 4.2B
FEB 9 1987
13:14:51
PLOT NO. 1
PREP7 ELEMENTS
TNUM=1

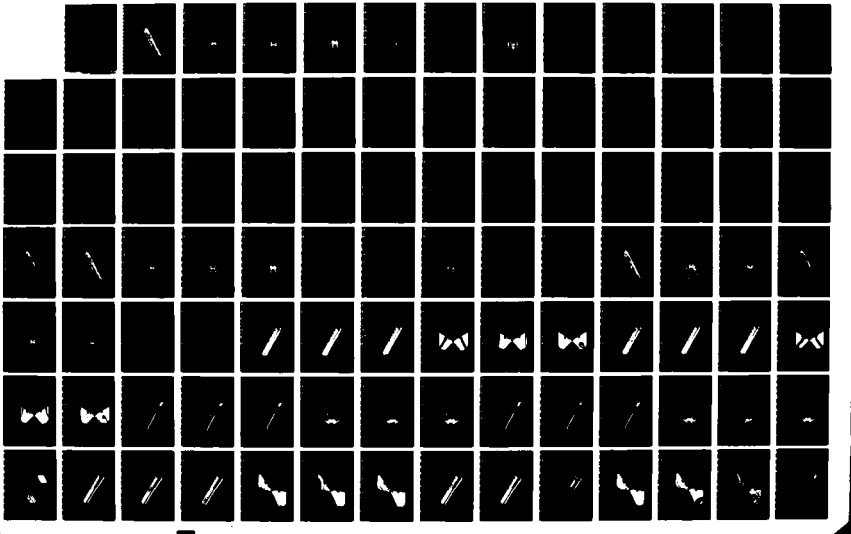
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115

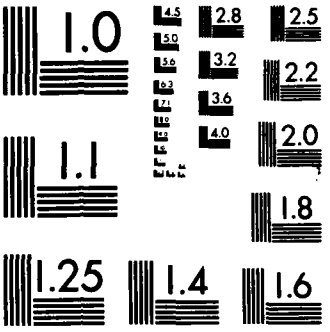
FIGURE 2


ANSYS 4.2B
FEB 9 1987
13:15:08
PLOT NO. 2
PREP7 ELEMENTS
RNUM=1
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115

AD-A183 991 LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN NORTHERN ORDNANCE DIV R RATHE ET AL APR 87 2/5

UNCLASSIFIED FMC-E-3041-VOL-D2-PT-3 DAAA21-86-C-0047 F/G 19/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FIGURE 3

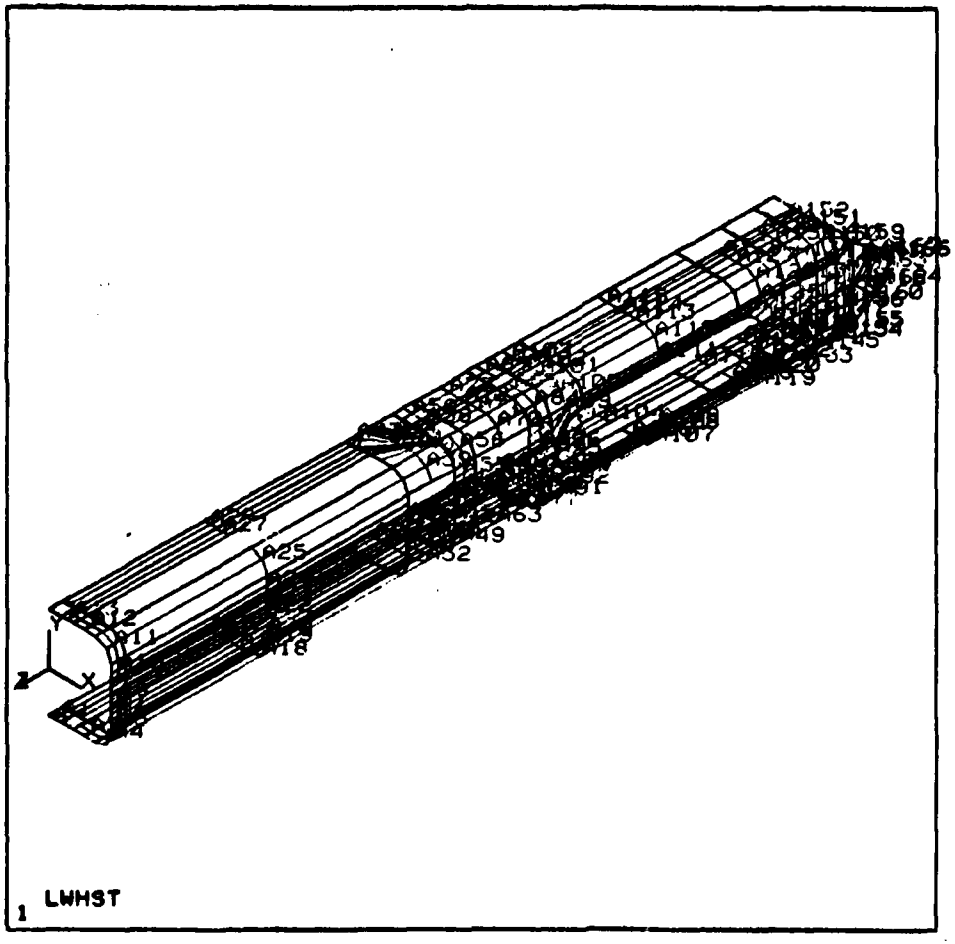

ANSYS 4.2B
FEB 9 1987
13:15:23
PLOT NO. 3
PREP7 AREAS
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.33
ZF=-116
LWHST
1

FIGURE 4

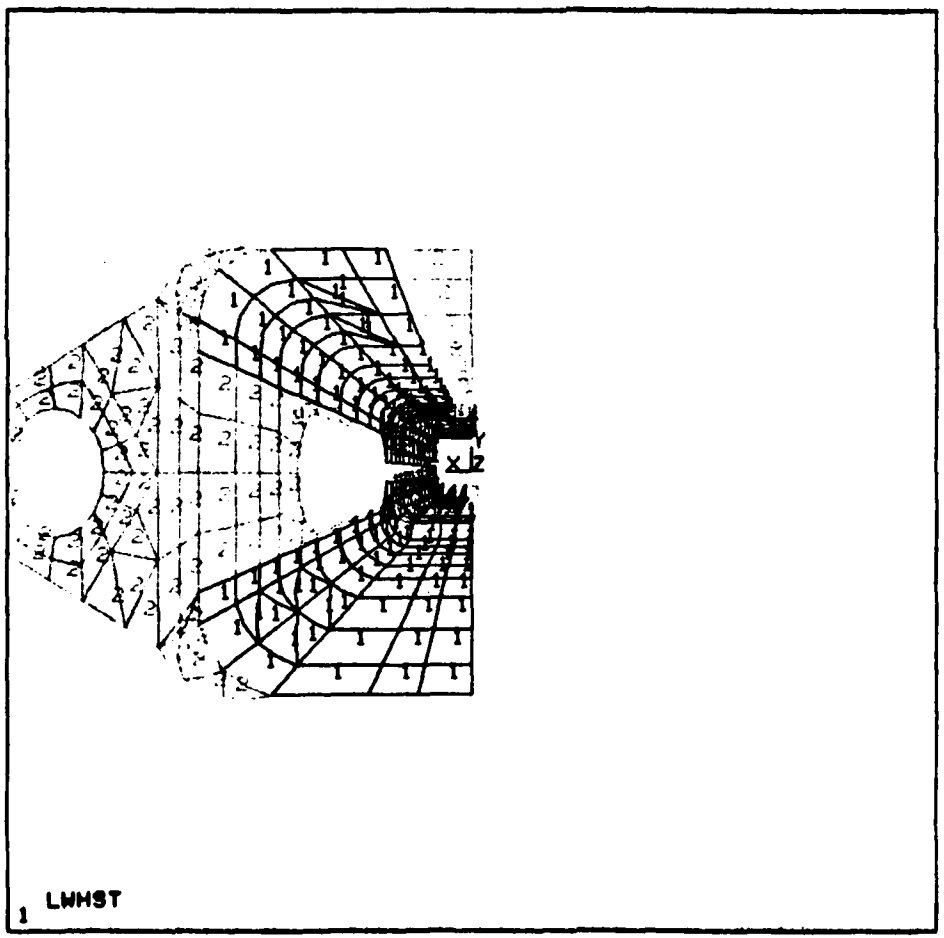

ANSYS 4.2B
FEB 9 1987
13:15:58
PLOT NO. 4
PREP7 ELEMENTS
TNUM=1
ZV=-1
* DIST=139
* ZF=-119
CONE=40
Y
X Z
1 LWHST

FIGURE 5

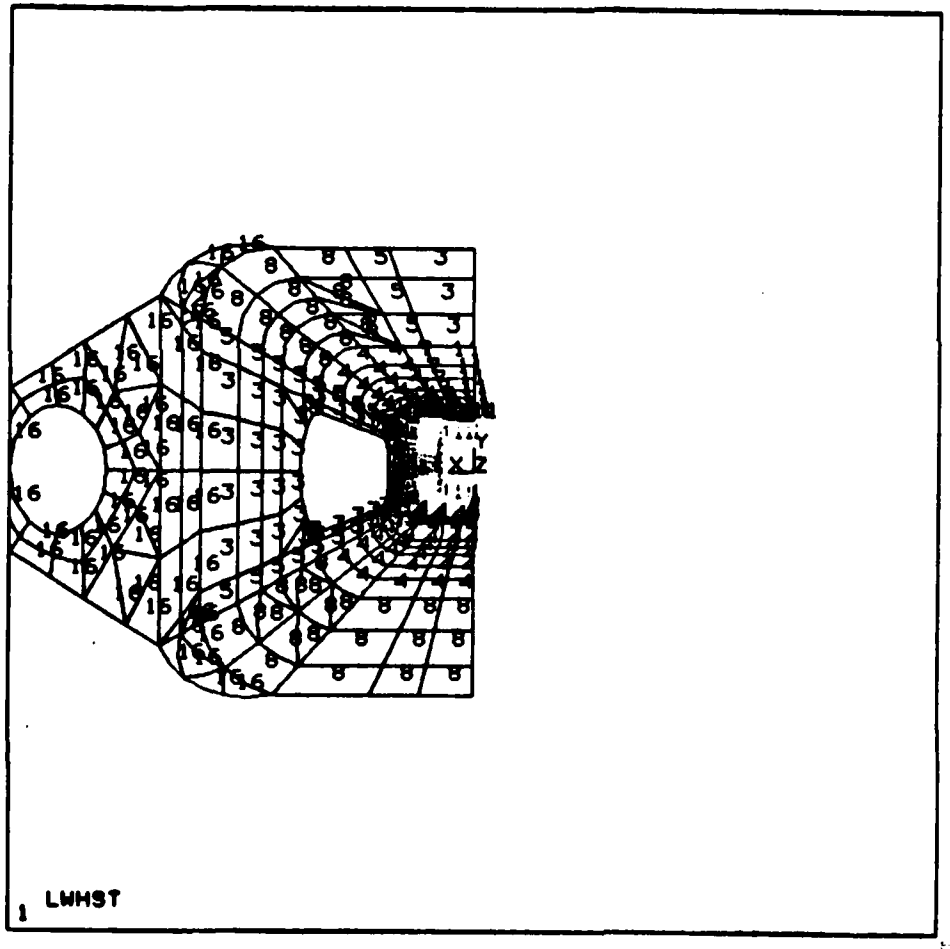

ANSYS 4.2B
FEB 9 1987
13:16:13
PLOT NO. 5
PREP7 ELEMENTS
RNUM=1
ZV=-1
* DIST=139
* ZF=-119
CONE=40
LWHST
1

FIGURE 6

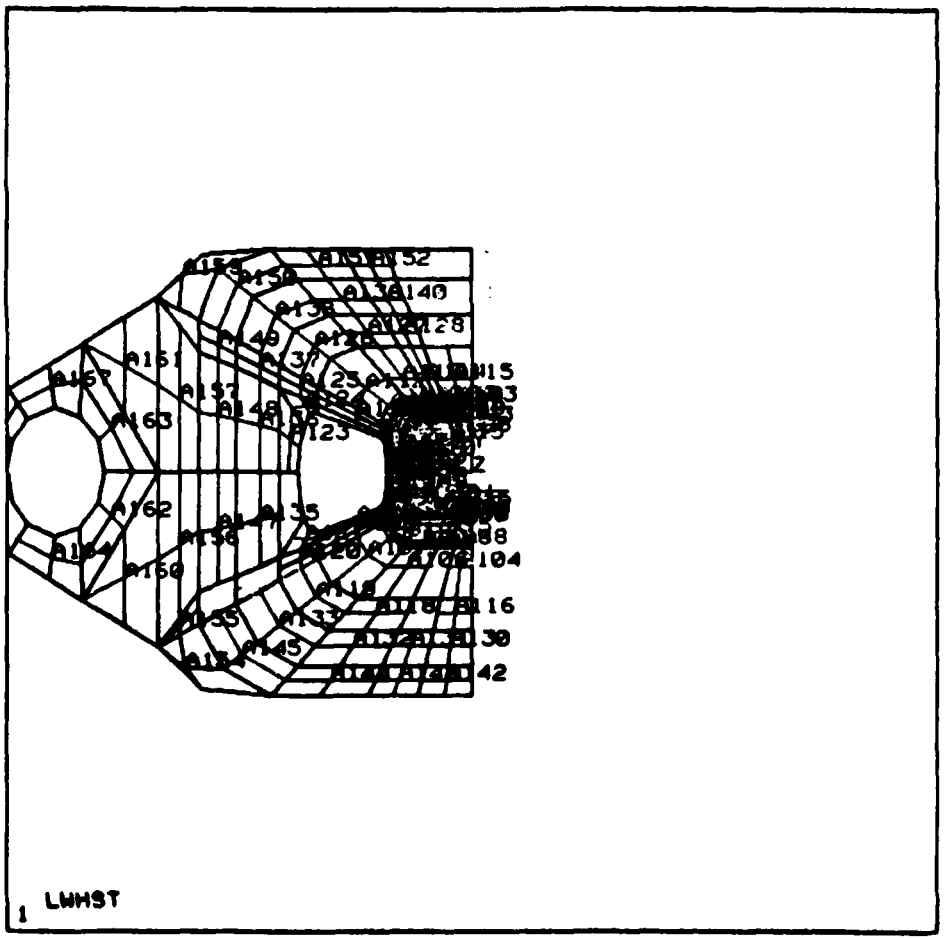

ANSYS 4.2B
FEB 9 1987
13:16:28
PLOT NO. 6
PREP7 AREAS
ZV=-1
* DIST=139
* ZF=-119
CONE=40
1 LWHST

FIGURE 7

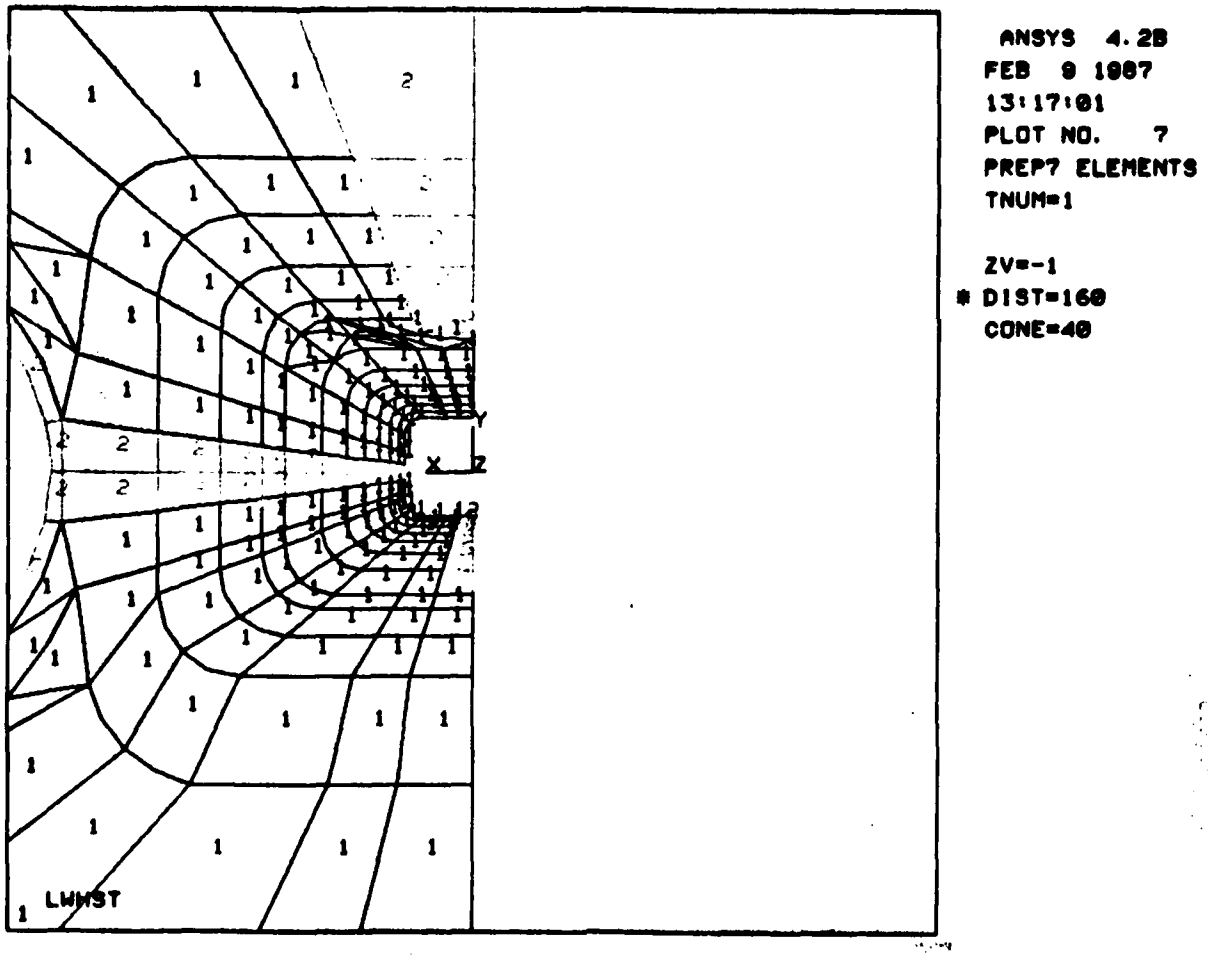

ANSYS 4.2B
FEB 9 1987
13:17:01
PLOT NO. 7
PREP7 ELEMENTS
TNUM=1
ZV=-1
DIST=160
CONE=40
LWHST

FIGURE 8

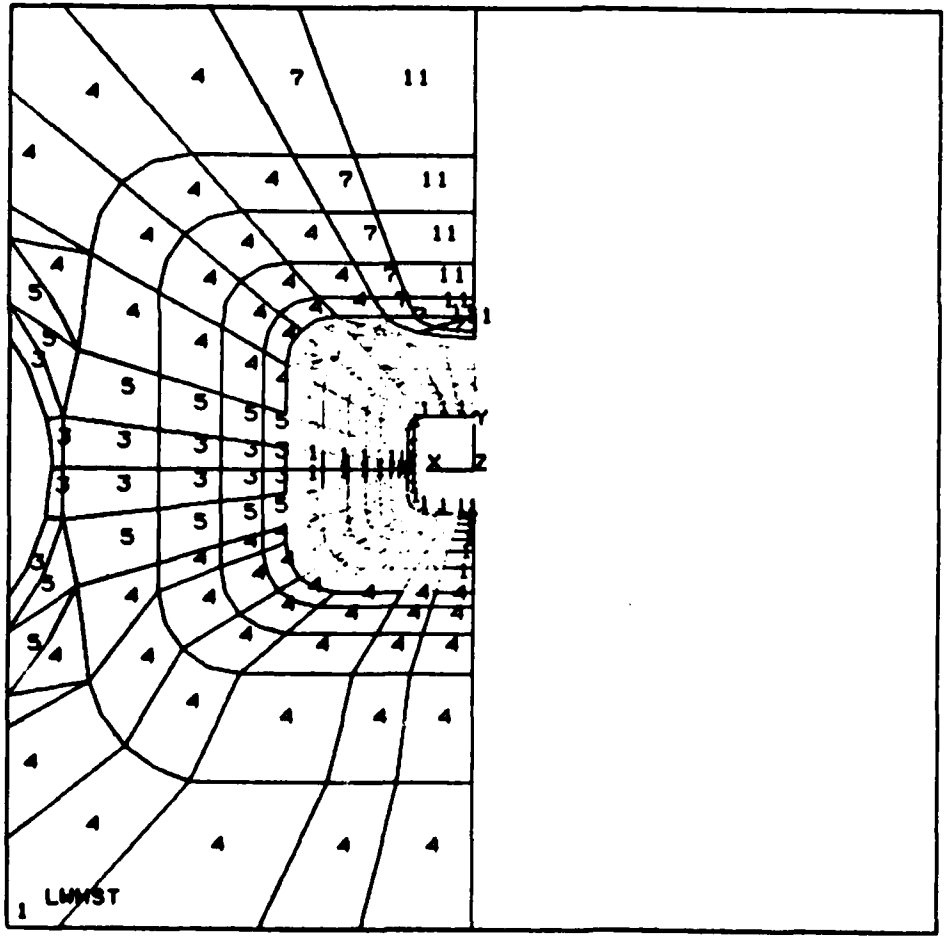
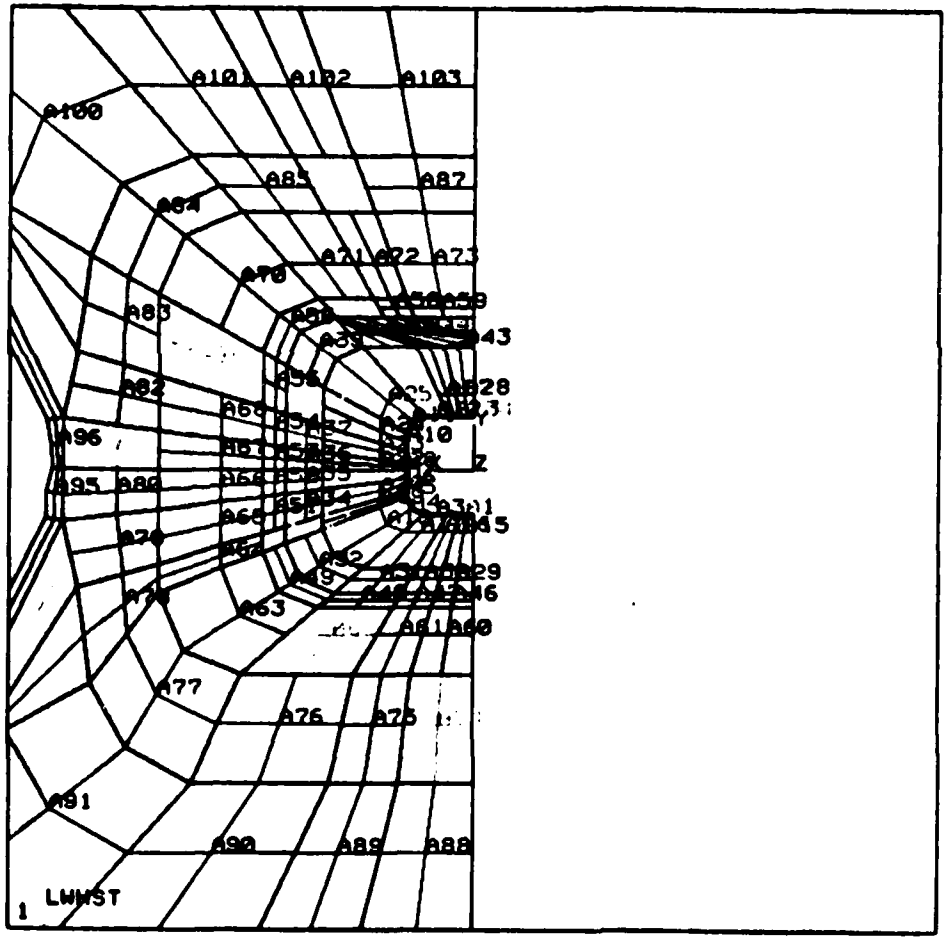

ANSYS 4.2B
FEB 9 1987
13:17:10
PLOT NO. 8
PREP7 ELEMENTS
RNUM=1
ZV=-1
DIST=160
CONE=40
LWHST

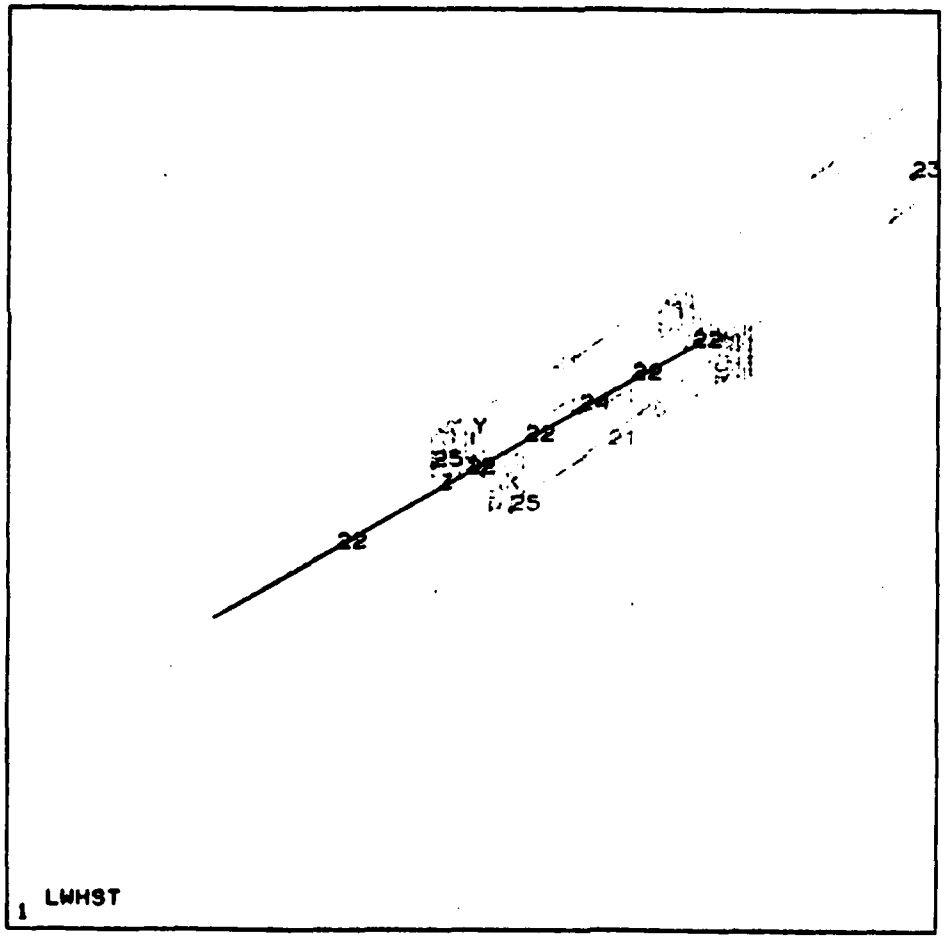
FIGURE 9



ANSYS 4.2B
FEB 9 1987
13:17:20
PLOT NO. 9
PREP7 AREAS

ZV=-1
# DIST=160
CONE=40

FIGURE 10



ANSYS 4.2B
FEB 9 1987
13:17:44
PLOT NO. 10
PREP7 ELEMENTS
RNUM=1

XV=1
YV=1
ZV=1
# DIST=160

FIGURE 11

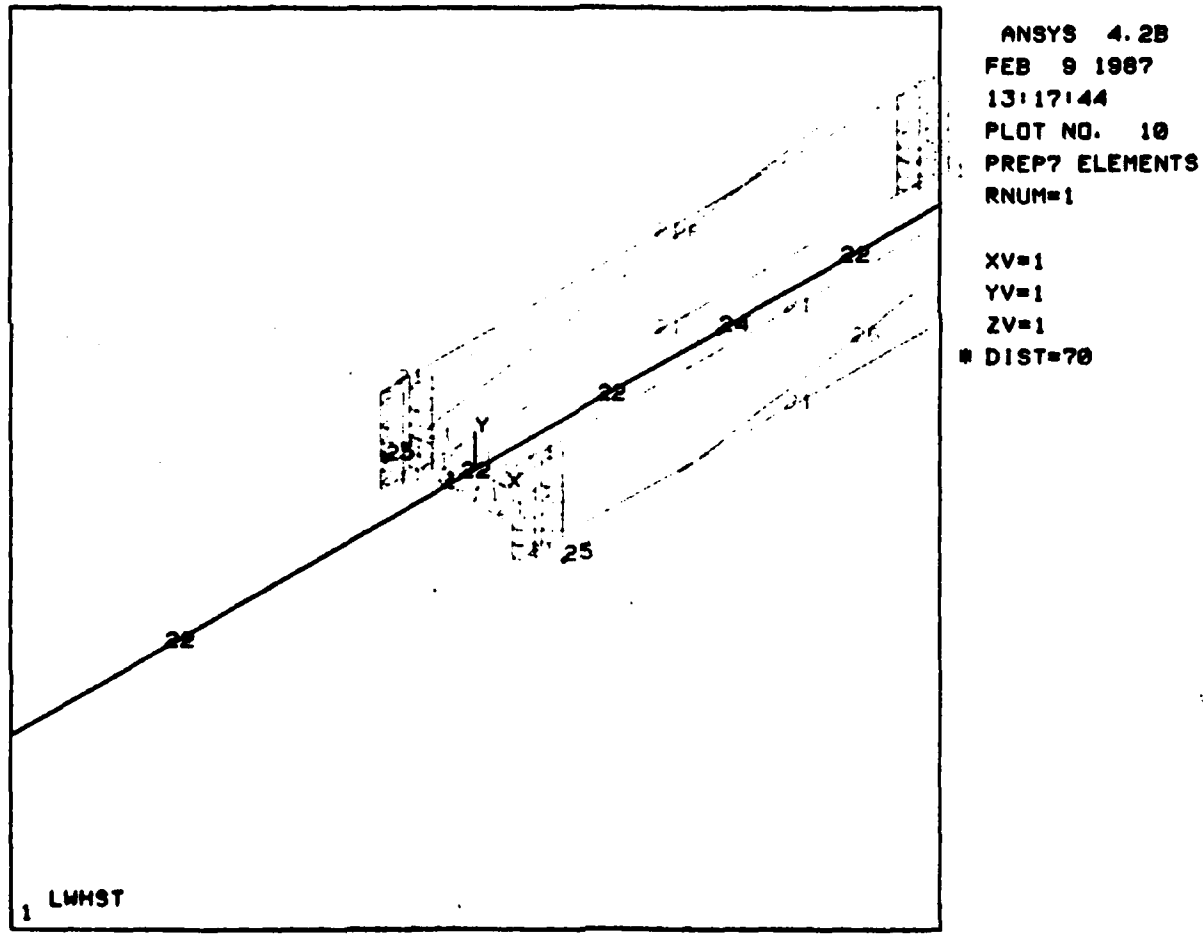
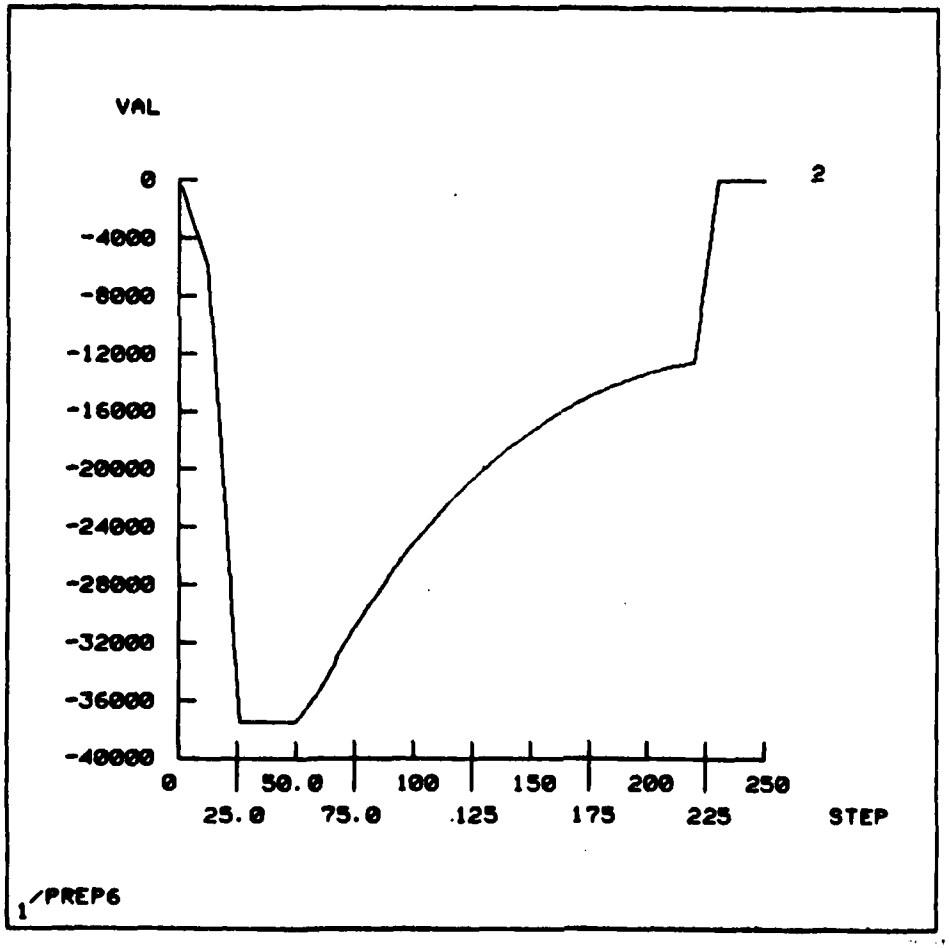

ANSYS 4.2B
FEB 9 1987
13:17:44
PLOT NO. 10
PREP7 ELEMENTS
RNUM=1
XV=1
YV=1
ZV=1
* DIST=70
22
24
22
22
25
25
Y
X
1 LWHST

FIGURE 12

RECOIL LOAD

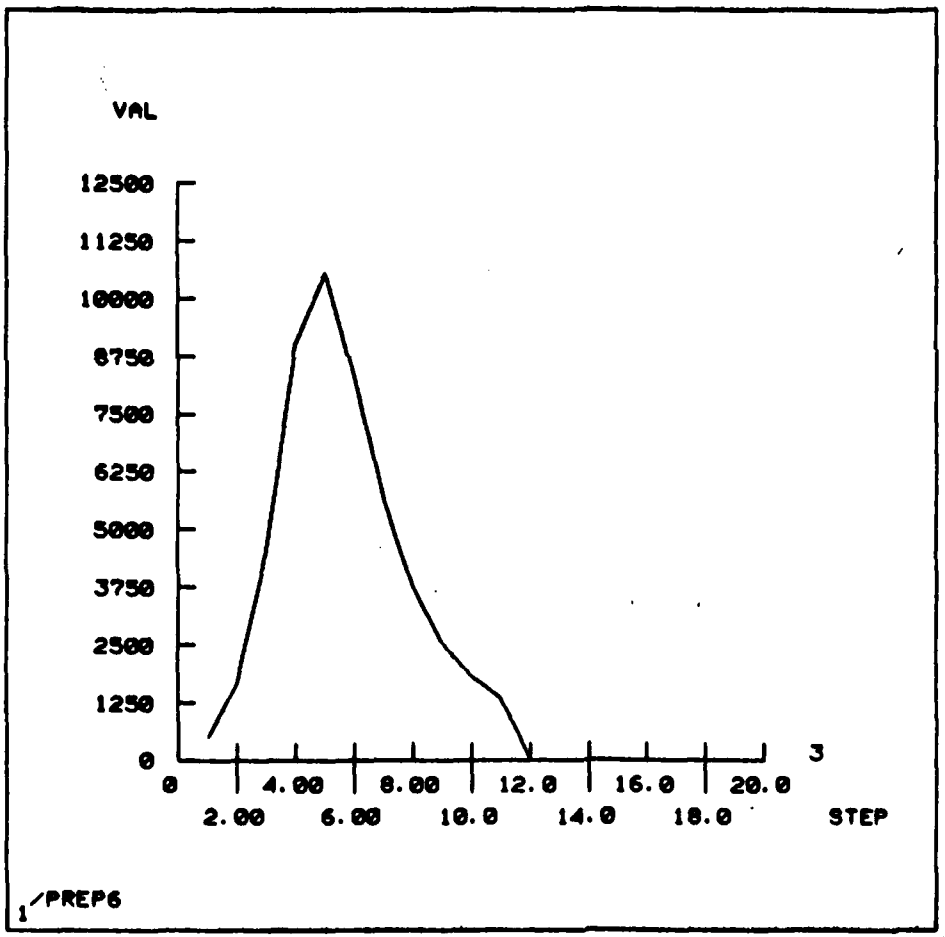


ANSYS 4.2B
FEB 9 1987
16:36:34
PREP6

ZV=1
DIST=1.43

FIGURE 13

TORQUE LOAD

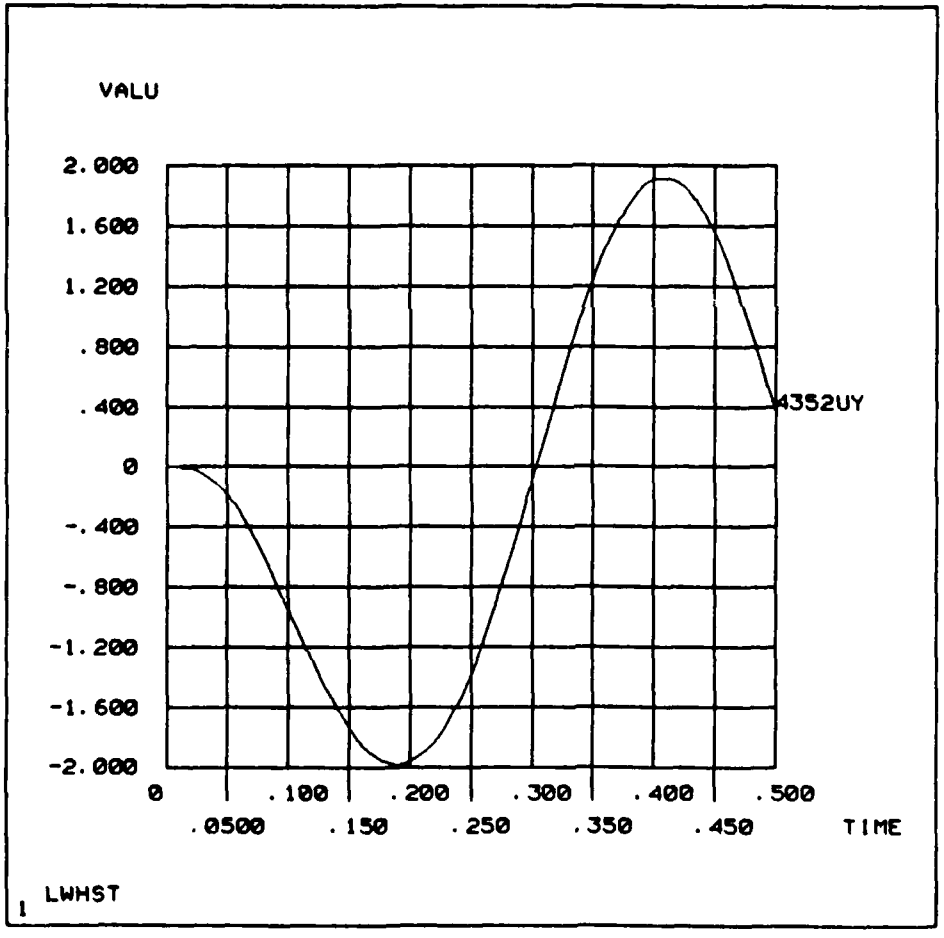


ANSYS 4.2B
FEB 9 1987
16:36:12
PREP6

ZV=1
DIST=1.43

FIGURE 17

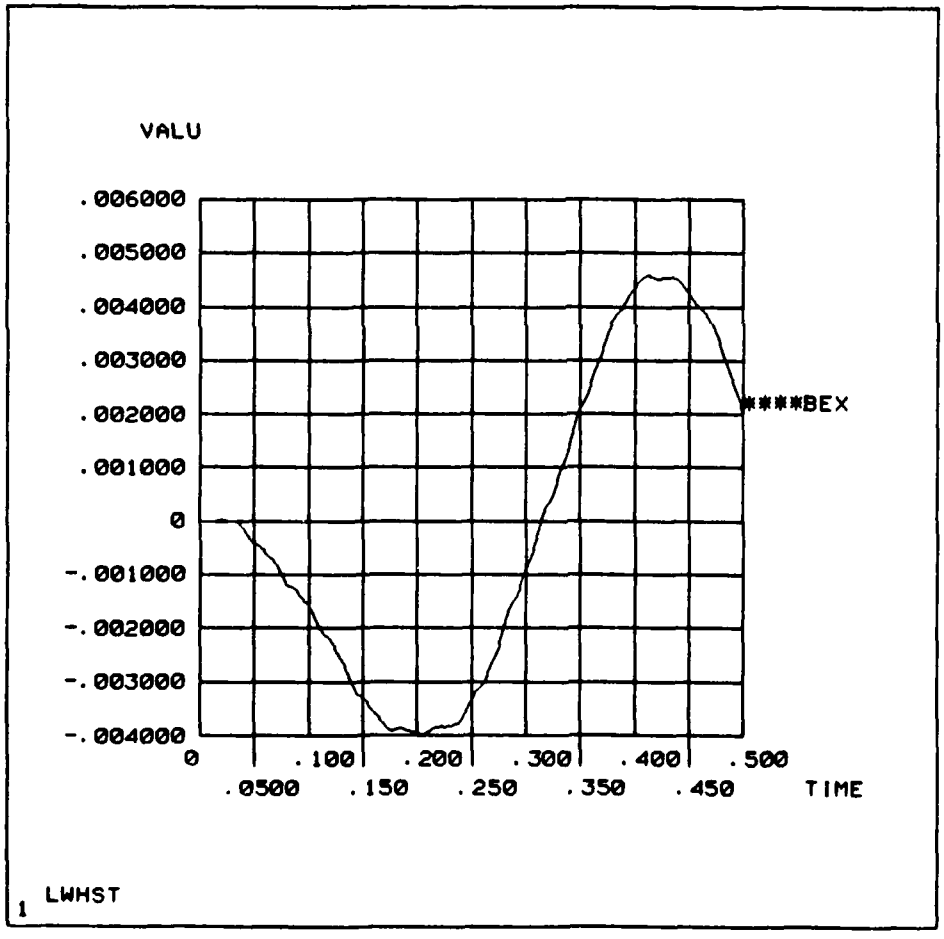
RECOIL LOAD



ANSYS 4.2B
FEB 9 1987
16:49:32
PLOT NO. 4
POST26

ZV=1
DIST=1.38

FIGURE 20
RECOIL FORCE
BARREL END - UX

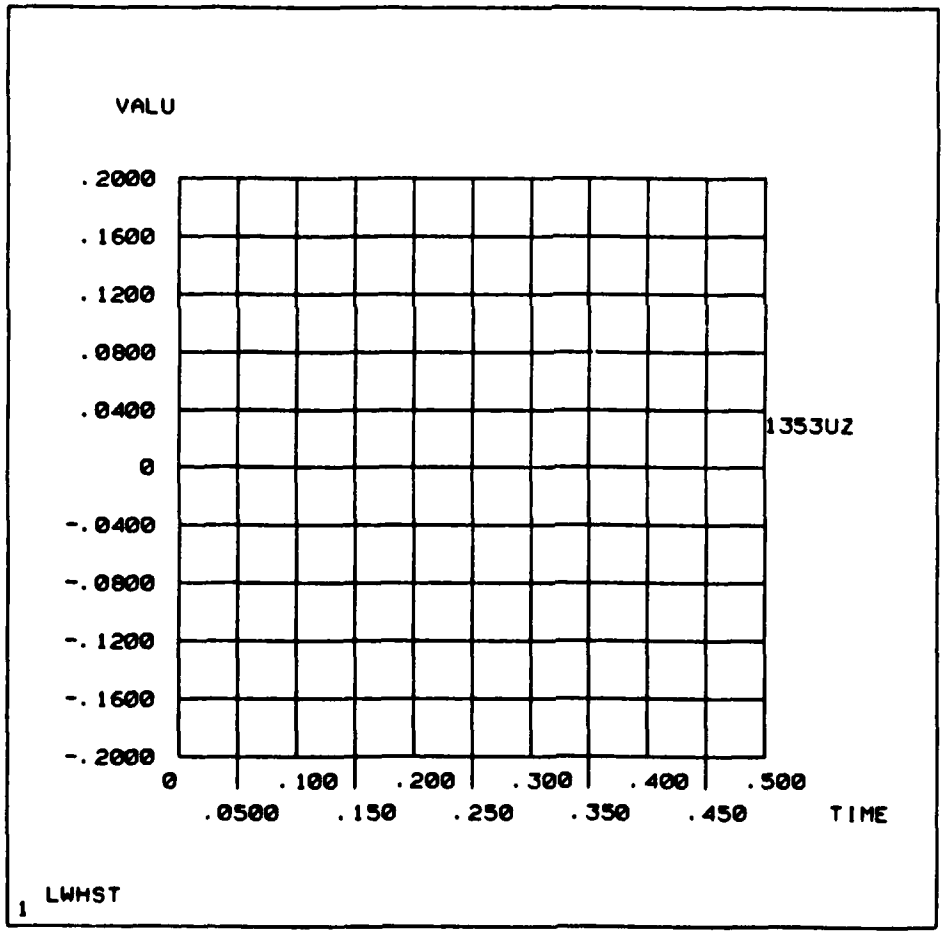


ANSYS 4.2B
FEB 9 1987
16:49:43
PLOT NO. 7
POST26

ZV=1
DIST=1.54

FIGURE 14

RECOIL LOAD

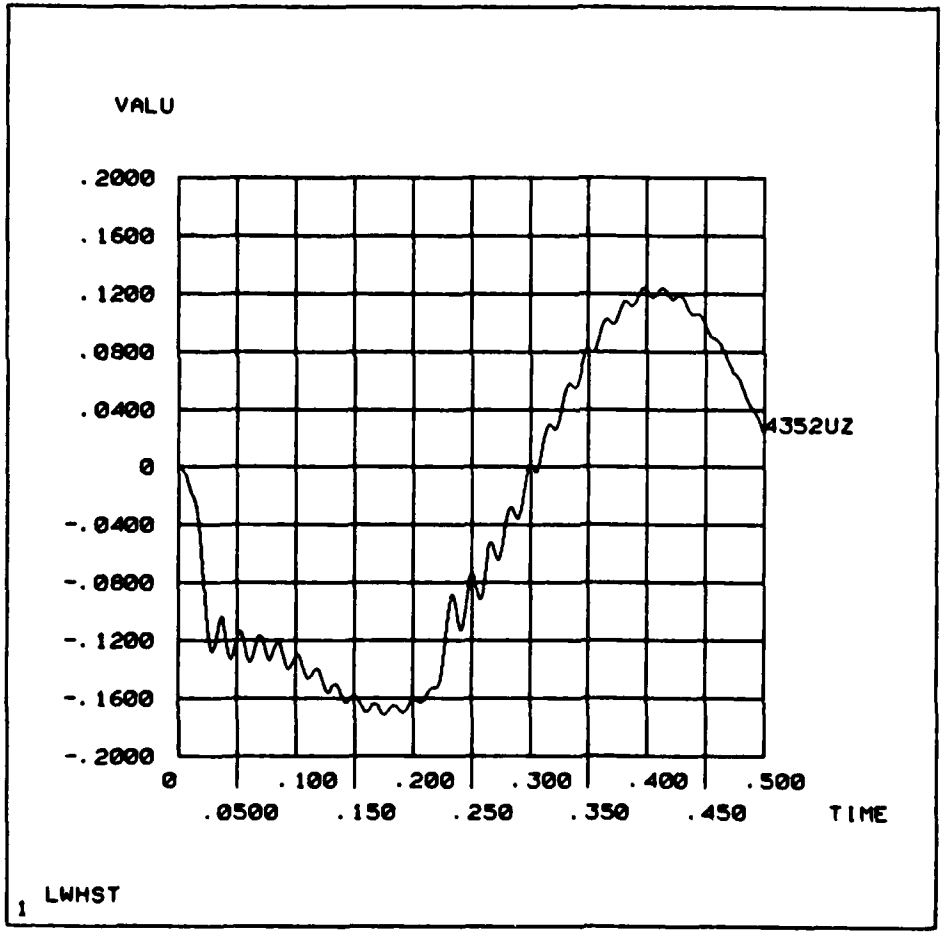


ANSYS 4.2B
FEB 9 1987
16:49:16
PLOT NO. 1
POST26

ZV=1
DIST=1.43

FIGURE 15

RECOIL LOAD

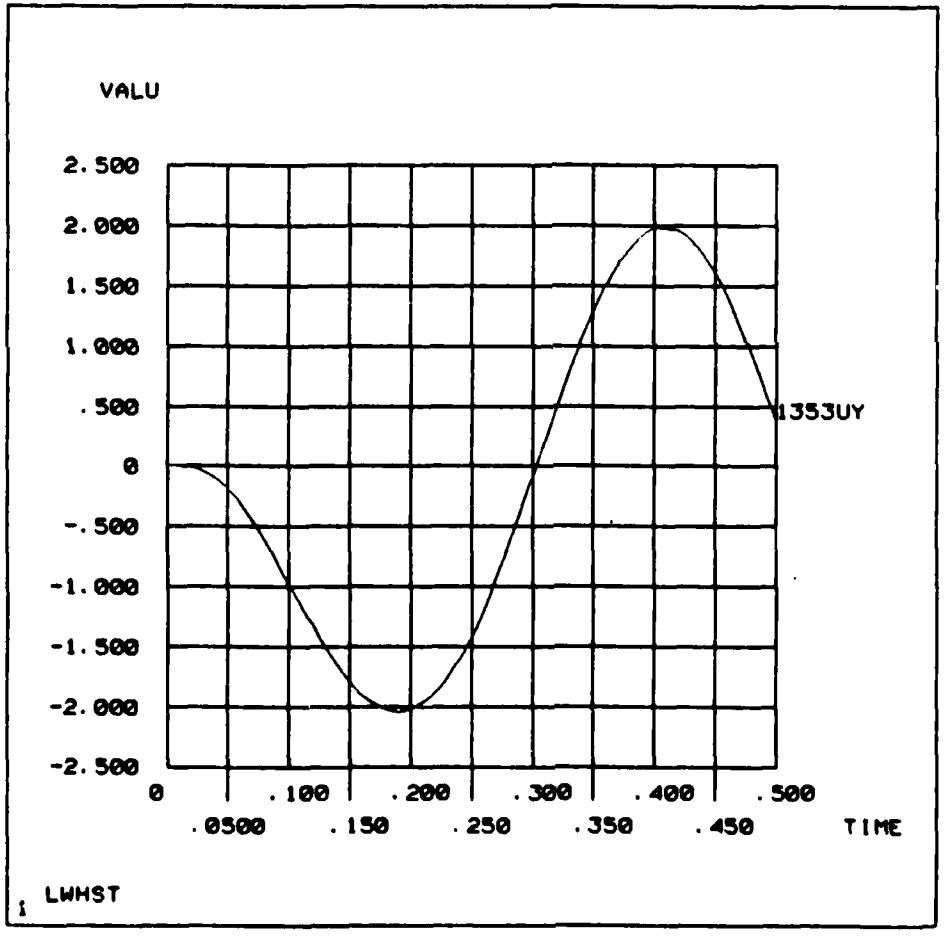


ANSYS 4.2B
FEB 9 1987
16:49:22
PLOT NO. 2
POST26

ZV=1
DIST=1.43

FIGURE 16

RECOIL LOAD



ANSYS 4.2B
FEB 9 1987
16:49:25
PLOT NO. 3
POST26

ZV=1
DIST=1.38

FIGURE 18

RECOIL LOAD

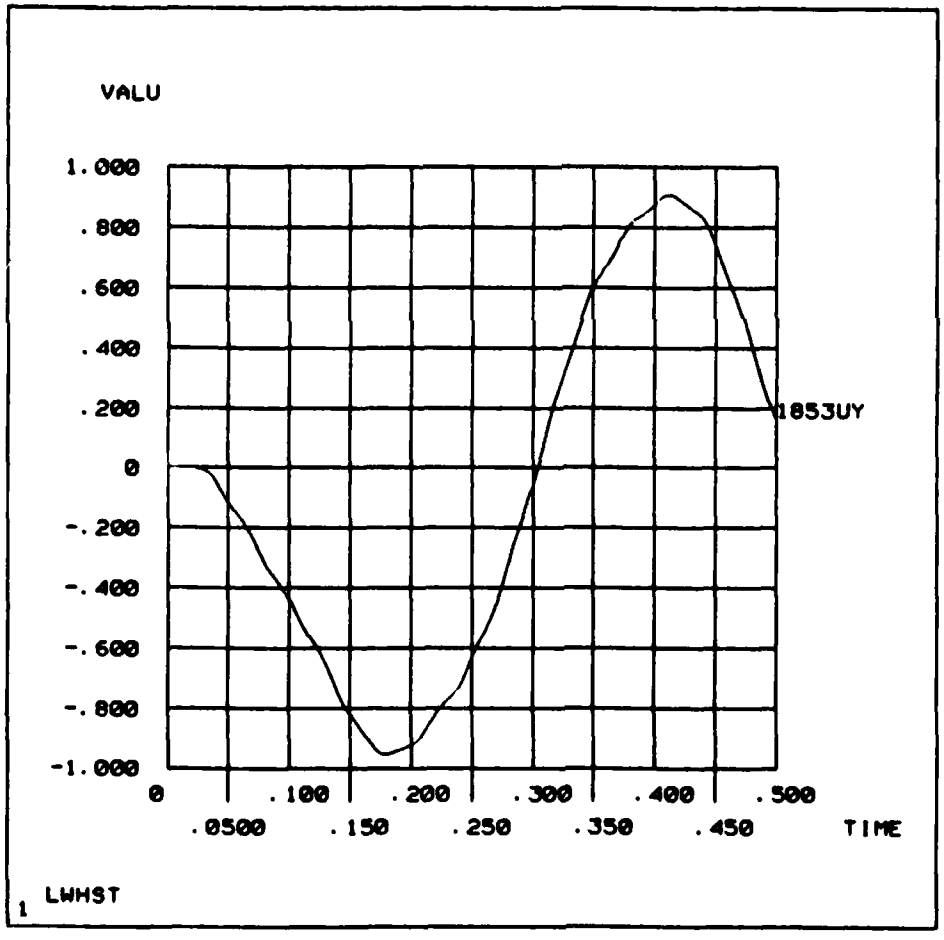
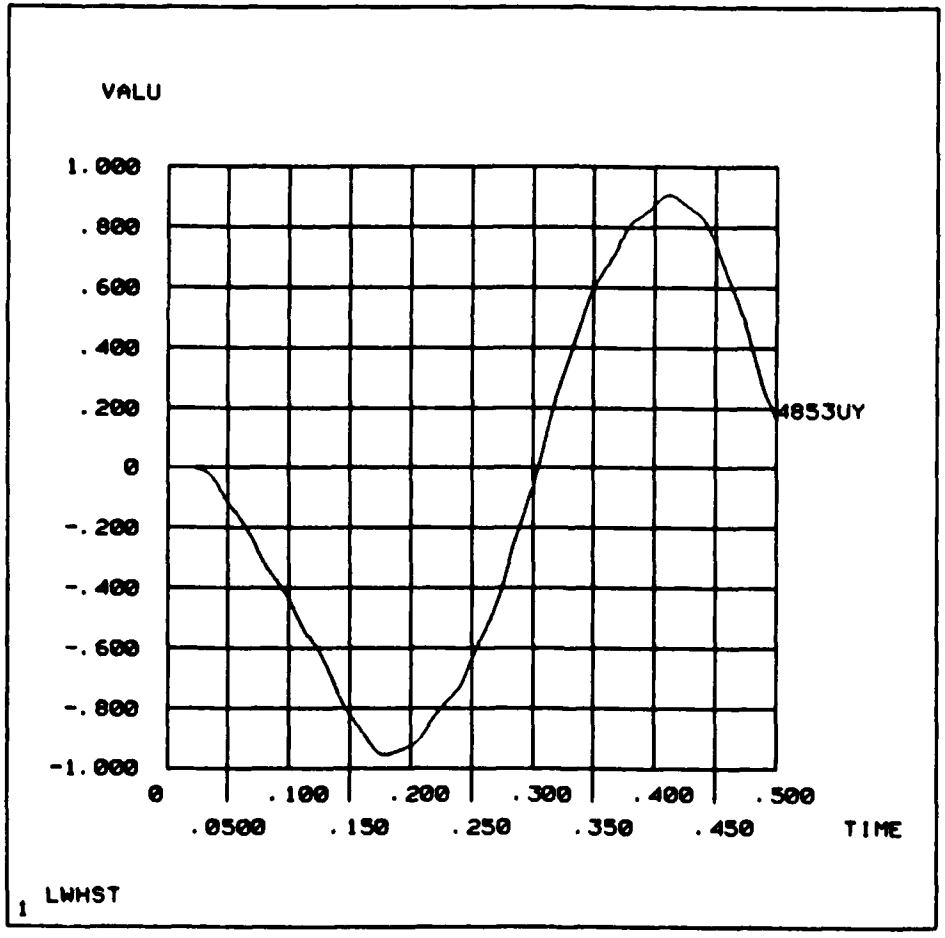


FIGURE 19

RECOIL LAOD

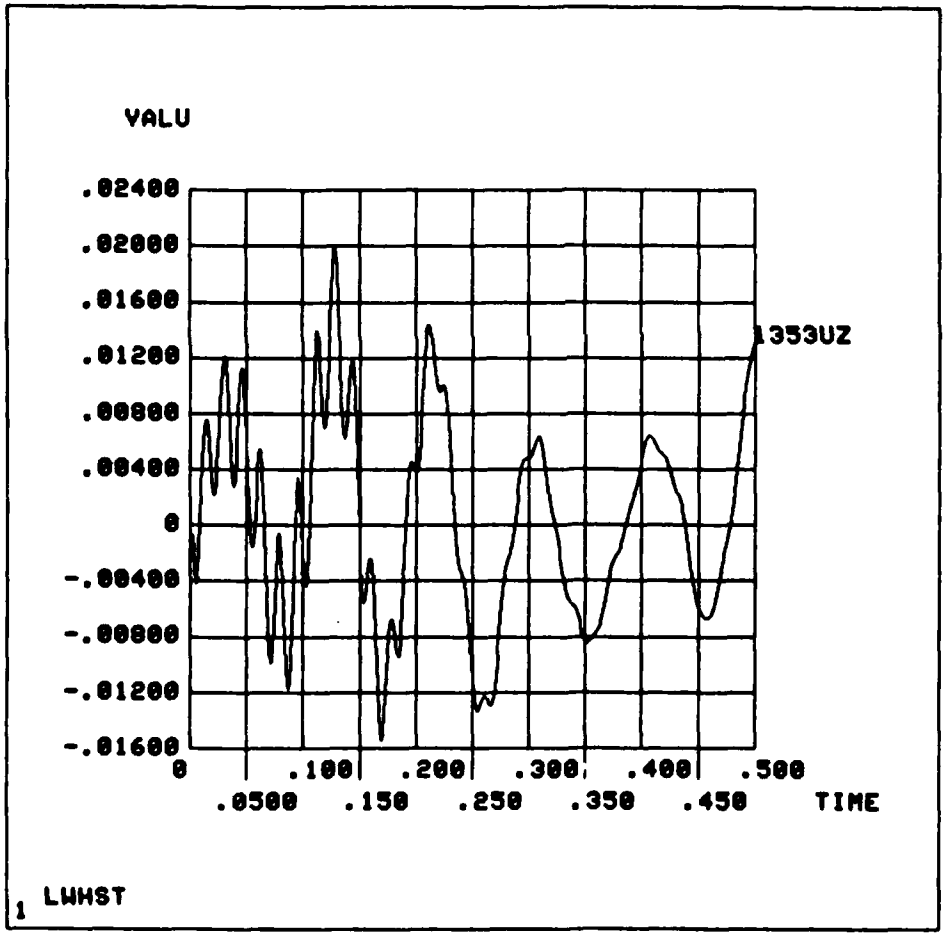


ANSYS 4.2B
FEB 9 1987
16:49:39
PLOT NO. 6
POST26

ZV=1
DIST=1.38

FIGURE 21

TORQUE LOAD

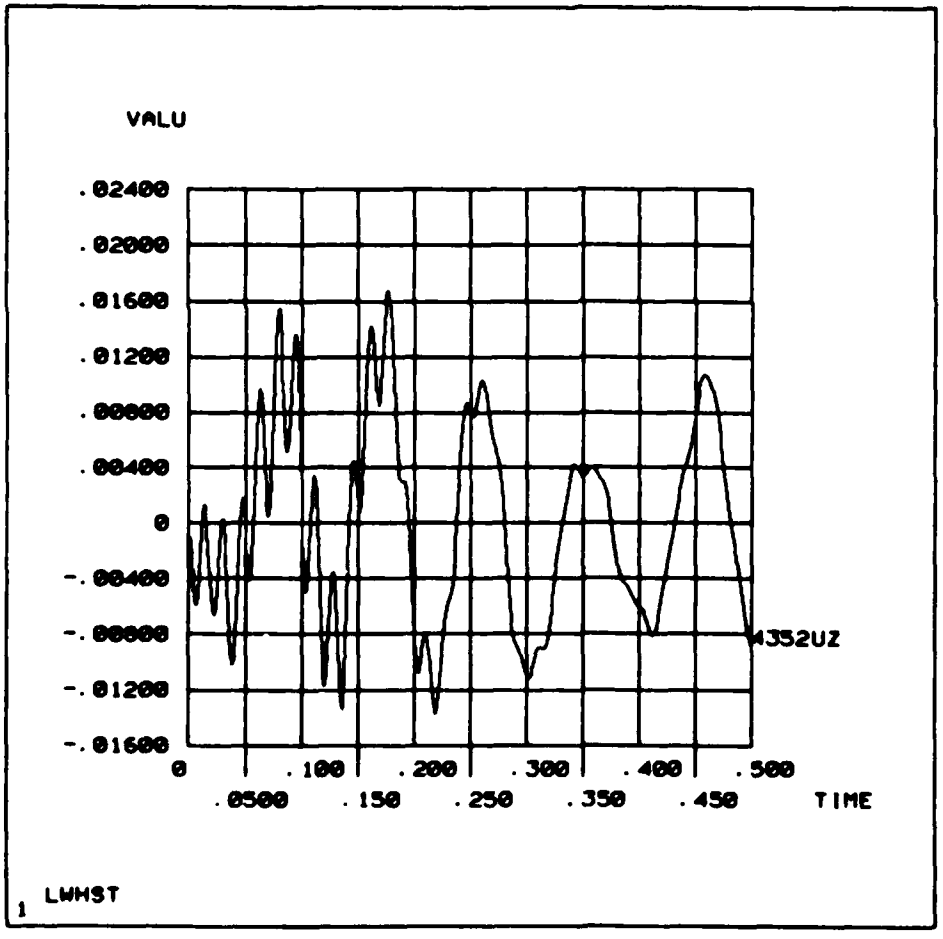


ANSYS 4.2B
FEB 10 1987
12:20:59
PLOT NO. 1
POST26

ZV=1
DIST=1.49

FIGURE 22

TORQUE LOAD

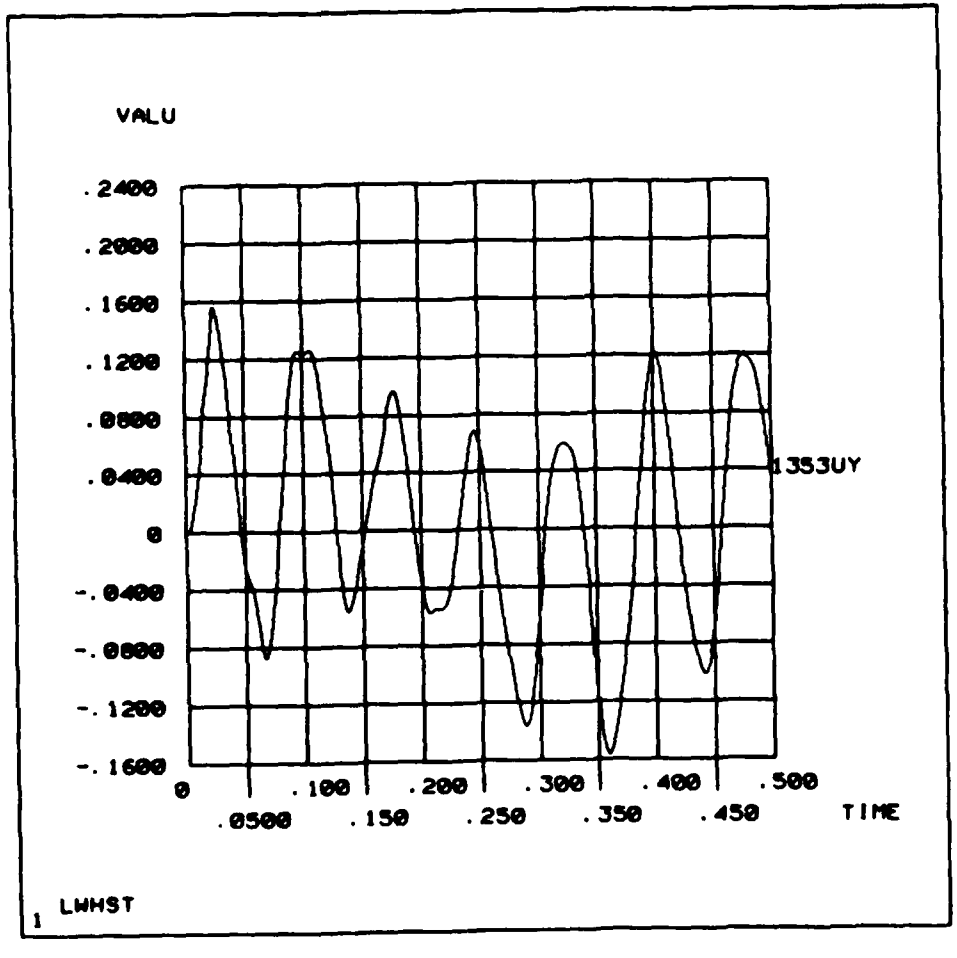


ANSYS 4.2B
FEB 10 1987
12:21:05
PLOT NO. 2
POST26

ZV=1
DIST=1.49

FIGURE 23

TORQUE LOAD

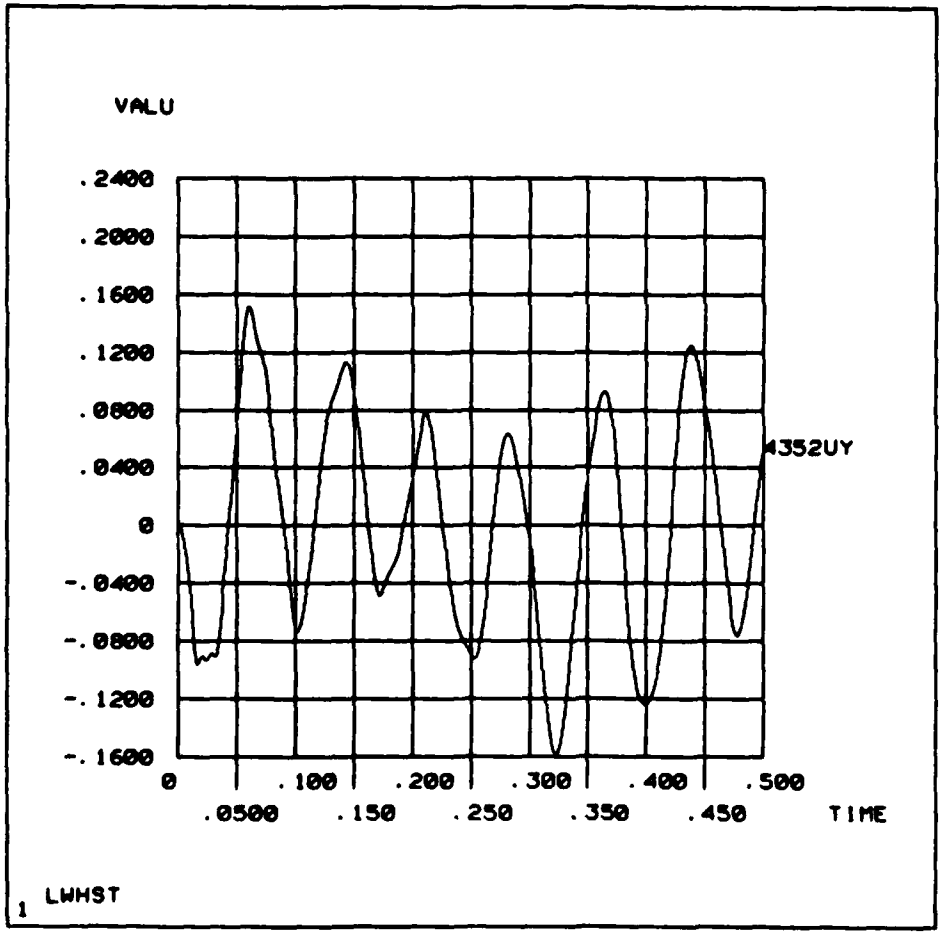


ANSYS 4.2B
FEB 10 1987
12:21:07
PLOT NO. 3
POST26

ZV=1
DIST=1.43

FIGURE 24

TORQUE LOAD

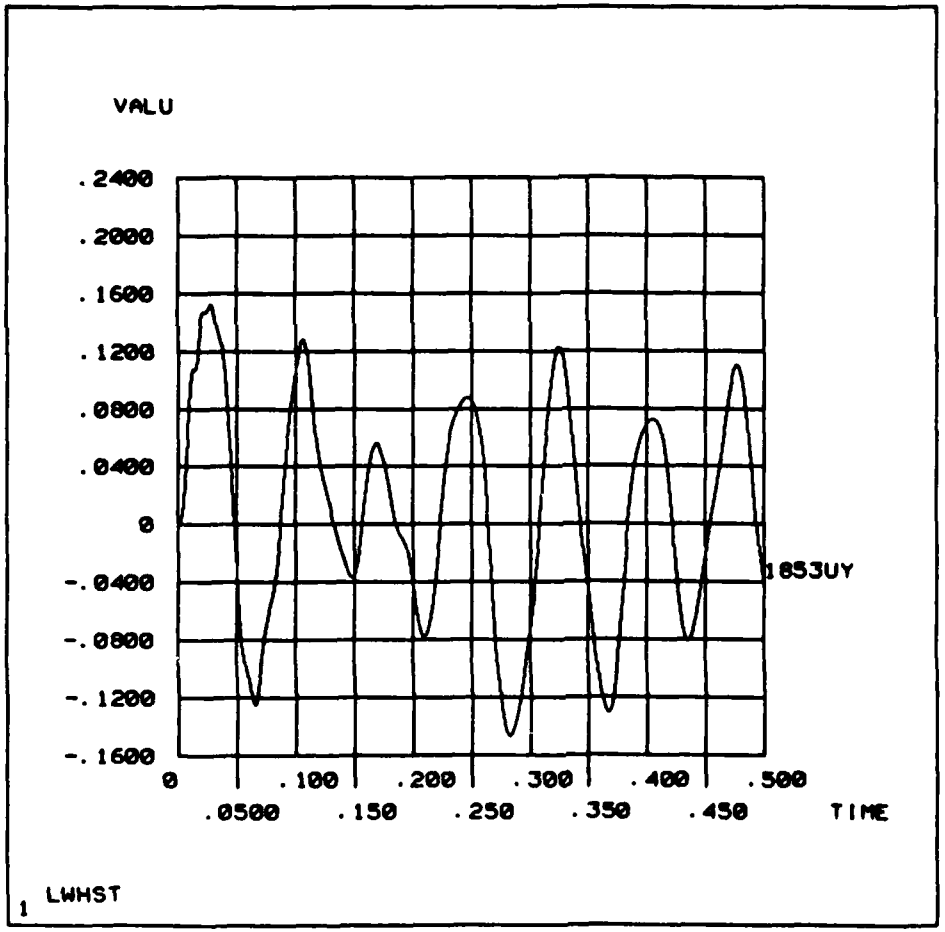


ANSYS 4.2B
FEB 10 1987
12:21:10
PLOT NO. 4
POST26

ZV=1
DIST=1.43

FIGURE 25

TORQUE LOAD

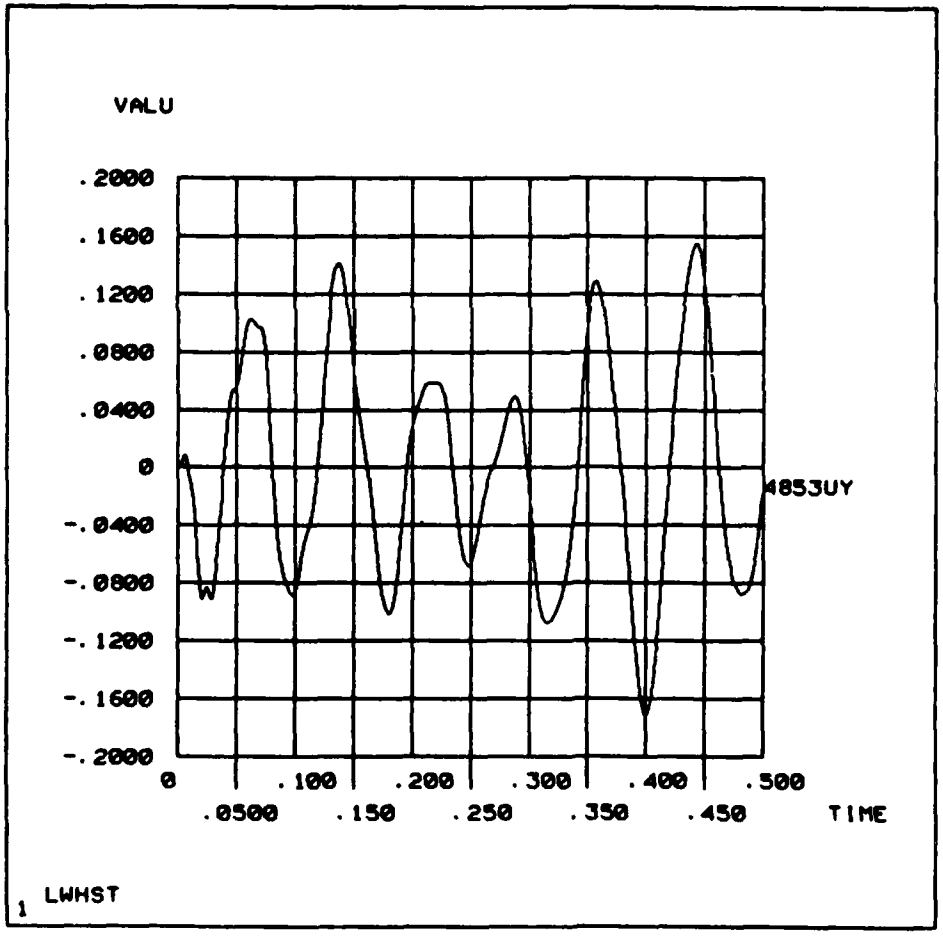


ANSYS 4.2B
FEB 10 1987
12:21:14
PLOT NO. 5
POST26

ZV=1
DIST=1.43

FIGURE 26

TORQUE LOAD

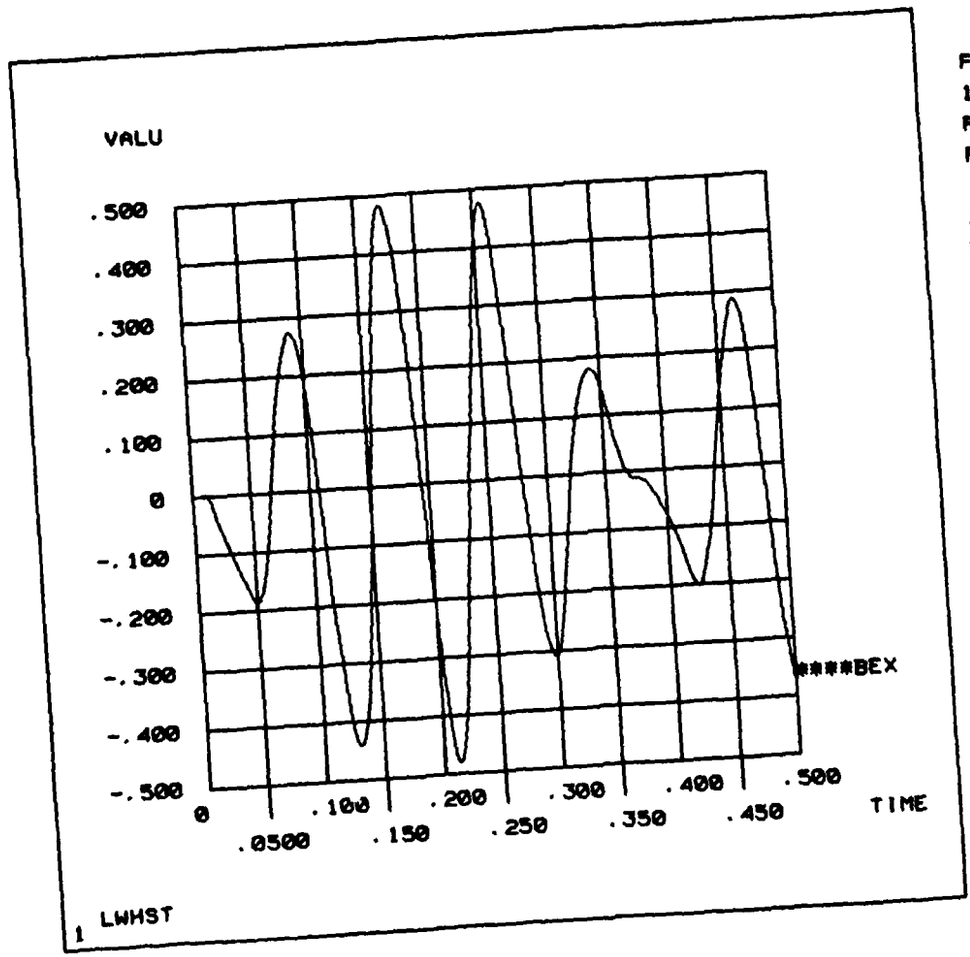


ANSYS 4.2B
FEB 10 1987
12:21:18
PLOT NO. 6
POST26

ZV=1
DIST=1.43

FIGURE 27

TORQUE LOAD



COMPUTER RESULTS - MODEL 11

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/PROBE,1
/PREP7
/TITLE, LWNST
KAN,5
ET,1,91,C,,3,3,,1
KEYOPT,1,7,1
ET,2,93
ET,3,45
ET,4,96
LCCAL,11,1,14,10.75
,12,1,19,0,-232.3,0,-90
,13,1,14,-7.5
,14,1,0,15.75,-104,0,C,-90
,15,1,14,-11
,16,1,0,0,-142.5,0,-90,0
,17,1,0,C,-19C,0,-90,0
CSYS,0
K,1,0,-12.5
,2,3.75,-12.5
,3,7.2,-12.5
CSYS,13
K,4,5.0,-90
,5,5.0,0
CSYS,0
K,6,19,-5.75
K,7,19,-2.4
,8,19,0
,9,19,2.4
K,10,19,5.75
CSYS,11
K,11,5.0,0
K,12,5.0,90
CSYS,0
K,13,7.2,15.75
,14,3.75,15.75
,15,C,15.75
L,1,2,1
,2,3,1
,3,6,1
CSYS,13
L,4,5,2
CSYS
L,5,6,1
,6,7,1
,7,8,1
,8,9,1
,9,10,1
,10,11,1
CSYS,11
L,11,12,2
CSYS
L,12,13,1
,13,14,1
,14,15,1
LGEN,2,1,14,1,0,0,-4.375,20
,2,1,14,1,0,C,-9C,40
,2,1,14,1,0,C,-1C4,60
,2,1,14,1,0,C,-110,80
KPOD,73,9
,74,6
L,72,73,1
RP3,1,1
LGEN,2,43,56,1,0,0,-6,20
LGEN,2,43,56,1,0,0,-22.5,40
```

transient input file

LTHD

MODEL 11

RCVD LJL 2-12-87

+ transient

of Feb. 11 work

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LGEN,2,43,56,1,0,0,-28.5,60
KROD,121,,-15.75
RP4,1
KPOD,125,,-10.75
CSYS,13
L,124,125,2
CSYS
LGEN,2,85,98,1,0,0,-10,20
LGEN,2,85,98,1,0,0,-57.5,40
LGEN,2,85,98,1,0,0,-71,60
LGEN,2,85,98,1,0,0,-81.062,80
LGEN,2,85,98,1,0,0,-87.062,100
/VIEW,,1,1,1
CSYS,14
K,,9,-90
K,,6,-90
L,17,74,2
,16,73,2
CSYS
L,54,16,1
,56,72,2
,53,72,2
,52,72,2
CSYS,16
LDEL,103,108
RP4,14,14
KPOD,126,10.75,-135
,130,10.75,135
CSYS,0
KPOD,127,,,-134.899
RP3,1
L,125,126,1
RP6,1,1
CSYS,16
K,,7.5,180,15
KMOVE,126,0,19,-5.75,999,16,10.75,999,999
KPOVE,130,0,19,5.75,999,16,10.75,999,999
,127,0,19,-2.4,999,16,8.5,999,999
,129,0,19,2.4,999,16,8.5,999,999
CSYS
KFILL,127,129,1,128
L,125,126,1
RP6,1,1
CSYS,16
L,145,126,2
L,130,131,2
KPOD,146,8.5
RP2,4
L,146,127,2
,129,150,2
KMOD,147,7.5
RP2,2
K,,7.5,-163,19
K,,7.5,163,19
L,147,19,2
L,19,18,1
CSCIR,16,1
L,18,20,1
CSCIR,16,0
L,20,149,2
CSYS,0
KPOD,166,,-8.5
RP4,20
KPOD,167,,-7.5
RP4,20
CSYS,17
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K,168,7.5,0,19
CSYS
KPOD,169,,7.5
RP4,20
KPOD,170,,8.5
RP4,20
CSYS,17
L,167,168,2
,168,169,2
CSYS
L,166,167,1
,169,170,1
L,166,186,2
,170,190,2
L,186,206,2
,190,210,2
,205,206,1
,210,211,1
KEEL,187,189,2
RP2,20,20
LEIV,119
,120
L,186,188,2
RP3,20,20
L,188,190,2
RP3,20,2C
LEEL,160,164
A,1,2,22,21
RP14,1,1,1,1
A,21,22,42,41
RP14,1,1,1,1
A,41,42,62,61
RP11,1,1,1,1
A,52,53,72
,53,54,72
,54,16,73,72
,54,55,16
,73,16,17,74
,74,17,75
A,61,62,82,81
RP14,1,1,1,1
A,81,82,102,101
RP14,1,1,1,1
A,101,102,122,121
RP14,1,1,1,1
A,121,122,142,141
RP4,1,1,1,1
A,125,126,145
A,126,127,146,145
A,127,19,147,146
A,127,128,18,19
A,128,129,20,18
A,129,150,149,20
A,129,130,151,150
A,13C,131,151
A,131,132,152,151
RP4,1,1,1,1
A,141,142,162,161
RP6,1,1,1,1
A,149,15C,17C,169
RP6,1,1,1,1
A,161,162,182,181
RP5,1,1,1,1
A,166,167,36,186
A,36,168,188,186
A,168,37,190,188
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A,169,170,19C,37
A,17C,171,191,190
RP5,1,1,1,1
A,181,182,202,201
RP5,1,1,1,1
A,186,188,208,206
A,188,190,210,208
A,19C,191,211,210
RP5,1,1,1,1
A,201,202,222,221
RP5,1,1,1,1
A,206,208,228,226
RP2,2,2,2,2
A,210,211,231,230
RP5,1,1,1,1
EY,1,6.6E6  * CARBON GRAPHITE
EX,1,6.7E6
GXY,1,3.4E6
NUXY,1,.3
DENS,1,.C00155
EX,2,13E3  * CORE
EY,2,6E3
NUXY,2,.25
DENS,2,.899E-5
GXY,2,6E3
ASIZE,24
R,1,.081
R,2,1,0,.C405,.0405,.C405,.0405
RPORE,2,0,2,2,2,2
RPORE,1,C,.0405,.0405,.04C5,.C405
R,3,.324
R,4,1,0,.0675,.0675,.0675,.0675
RPORE,2,C,2,2,2,2
RPORE,1,C,.0675,.0675,.0675,.0675
R,5,1,0,.162,.162,.162,.162
RPORE,2,0,2,2,2,2
RPORE,1,C,.162,.162,.162,.162
R,6,1,0,.162,.162,.162,.162
RPORE,2,0,1,1,1,1
RPORE,1,0,.162,.162,.162,.162
R,7,1,0,.135,.135,.135,.135
RPORE,2,0,1,1,1,1
RPORE,1,C,.135,.135,.135,.135
R,8,1,0,.135,.135,.135,.135
RPORE,2,0,2,2,2,2
RPORE,1,0,.135,.135,.135,.135
R,9,1,0,.0405,.0405,.0405,.04C5
RPORE,2,0,1,1,1,1
RPORE,1,0,.0405,.0405,.04C5,.C405
R,11,.270
R,16,.81
EX,3,3.81E6 *ALUMINUMREDUCEDBY.37
EY,3,3.81E6
EZ,3,3.81E6
ALXY,3,.33
DENS,3,.C000546
C*** REAR TRIANGLE
CSYS,12
K,,3
K,,4.5
L,38,39
LGEN,2,334,,,C,45
LDEL,335
LGEN,2,334,,,C,90
LGEN,2,334,,,0,-90
L,57,38
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```
,38,39
,38,39
,39,60
K,,3,180
L,37,76
CSCIR,12,1
L,39,76
CSCIR,12,0
L,76,228
CSYS
K,,19,10.75,-224.562
K,,19,-10.75,-224.562
L,231,77
,225,78
,77,38
,78,60
CSYS,15
L,224,78
CSYS,11
L,232,77
CSYS
LDIV,343
A,224,229,78
A,225,226,78
,226,228,79,78
,228,230,77,79
,230,231,77
,231,232,77
LDIV,341
,342
LDIV,346,,.6
,347,,.6
A,78,79,98
A,79,77,97
A,79,76,96,98
,79,97,80,76
A,98,96,59,60
,60,59,38,39
,38,57,58,39
,60,97,58,57
C*** START MESH
KPALL
LSALL
AALL
PAT,1
TYPE,2
REAL,1
ELSI,15
CSYS
APESH,1,14
,15
,21,22
,29
,35,36
REAL,2
TYPE,1
APESH,17,19
,24,28
,31,33
,38,43
REAL,3
TYPE,2
APESH,52,53
,66,67
,80,81
,94,97
```

```
     ,109,110
     ,121,124
     ,129
     ,135,136
     ,141
     ,147,148
     ,153
     REAL,4
     TYPE,1
     APESN,46,50
     ,55,57
     ,60,64
     ,69,71
     ,76,78
     ,83,85
     ,88,92
     ,99,101
     ,104,107
     ,112,113
     REAL,5
     TYPE,1
     APESN,51
     ,54
     ,65
     ,68
     ,79
     ,82
     ,93
     ,98
     ,108,
     ,111
     ,120
     ,125
     ,128
     ,134
     ,137
     ,140
     ,146
     ,149
     ,152
     REAL,7
     TYPE,1
     APESN,44
     ,58
     ,72
     ,86
     ,102
     ,114
     REAL,8
     TYPE,1
     APESN,116,119
     ,126,127
     APESN,130,133
     ,138,139
     ,142,145
     ,150,151
     REAL,9
     TYPE,1
     APESN,16
     ,20
     ,23
     ,30
     ,34
     ,37
     REAL,11
     TYPE,2
```

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ARESH,45
,59
,73
,87
,103
,115
ELSI,4
REAL,16
TYPE,2
APESH,154,167
C*** MODIFY TOP ELEMENTS FOR ADDED CORE
TYPE,1
REAL,6
TYPE,1
REAL,7
C*** MANIFOLDS
KPAS,,1,15
KGEN,2,1,4,1,0,.001
KGEN,2,5,11,1,-.001
KGEN,2,12,15,1,0,-.001
KPUS,,1,15
KGEN,2,118,138,1,-6.999
KGEN,2,139,,,-6.999
KGEN,2,139,180,1,-6.8
KGEN,2,187,200,1,-3.45
KGEN,2,207,220,1,-3.75
CSYS,13
L,117,118,2
CSYS,11
L,139,140,2
CSYS
A,99,100,207,236
A,100,116,187,207
A,116,117,159,187
A,236,207,208,237
A,207,187,189,209
A,187,159,160,189
A,159,118,119,160
A,237,209,210,238
A,209,189,190,210
A,189,160,170,190
A,160,119,120,170
A,238,210,211,239
A,210,190,191,211
A,190,170,171,191
A,170,120,130,171
A,239,211,212,240
A,211,191,192,212
A,191,171,172,192
A,171,130,131,172
A,240,212,213,241
A,212,192,193,213
A,193,172,173,193
A,172,131,132,173
A,241,213,220,242
A,213,193,200,220
A,193,173,180,200
A,173,132,139,180
A,242,220,157,158
A,220,200,156,157
A,200,180,140,156
C*** TRIANGULAR AREAS
A,117,118,159
A,139,140,180
K,243,0,0,0
L,239,243
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```
VERAG,168,169,17C,171,172,173,437
VERAG,174,175,176,177,178,179,437
VERAG,180,181,182,183,184,185,437
VERAG,186,187,188,189,19C,191,437
VERAG,192,193,194,195,196,197,437
VERAG,198,,,,,,437
RP2,1
MERGE
PAT,3
TYPE,3
REAL,1
ESI,,1
VPESH,1,30
VPESH,31,32
ERSE,TYPE,3
NELER
NGEN,2,50C,ALL,,,0,0,-110
EGEN,2,5C0,ALL
EALL
NALL
C*** RECOIL CYLINDERS
ET,5,16
TYPE,5
PAT,5
REAL,21
R,21,5.25,,.456
E,1385,1384
,1384,1805
,1805,1824
E,1325,1323
,1323,1825
,1825,1823
PAT,8
ET,8,2986
DENS,8,0
E,1385,1375
,1375,1365
,1365,1355
,1355,1345
,1345,1333
,1333,1325
,1351,1350
,1350,1353
,1353,1355
E,1384,1374
,1374,1364
,1364,1354
,1354,1344
,1346,1332
,1332,1323
,1349,1348
,1348,1352
,1352,1354
EGEN,2,500,-10
C*** REFLECT
NALL
EALL
CSYS,0
SYMM,1,3CC0,ALL
ESYM,1,3C00,ALL
MERGE
C*** CANNON BARREL
TYPE,5
REAL,22
R,22,9.375,1.6375
PAT,5
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ET,5,2966
MLRT,5,.3
DENS,5,.0007331
N,10C01,0,0,125.76
N,10002,C,0,6
N,10003,G,0,C
,100C5,0,0,-104
FILL
N,10006,0,0,-110
E,10001,10002
EGEN,5,1,-1
C*** CABLES
N,10007,19,33,-244
,10009,19,-7.5,0
FILL
N,10010,-19,33,-244
N,10012,-19,-7.5
FILL
ET,6,4
TYPE,6
PAT,6
ET,6,2066
MLRT,6,.3
DENS,6,.00013
REAL,26
R,26,2.2,,.4,,4,1.5,1.5
E,10007,10008
,100C8,1C009
EGEN,2,3,-2
D,10007,UX,0,,10C10,3,UY,UZ,ROTY
C*** REAR PIVOT
CSYS,12
N,10013,G,0,C
N,10014,G,0,-38
CSYS
R,23,.001,,0C1,,C01
REAL,23
ET,7,21
TYPE,7
E,10C13
E,10C14
CSYS,0
CERI,10013,1227
,10013,1231
RP6,0,1
CERI,10013,1249
,10013,1253
RP5,C,1
CERI,10013,1267
RP3,G,1
CERI,10013,1283
RP2,C,1
CERI,10013,1291
RP2,0,1
CERI,10013,1302
RP3,0,1
CERI,10014,4227
,10014,4231
RP5,C,1
CERI,10014,4249
,10014,4553
RP5,C,1
CERI,10014,4267
RP3,G,1
CERI,10014,4283
RP2,0,1
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CERI,10014,4291
RP2,0,1
CERI,10014,4302
RP3,0,1
P,10013,UX,0,,10014,1,UY,UZ
C*** EXTRA MASS
TYPE,7
R,24,5.789,5.789,5.789,.636,.636,.636
REAL,24
E,10004
C*** EXTRA MASSES ON CABLES
TYPE,7
REAL,25
R,25,.214,.214,.214
E,10009
E,10012
RALL
C*** REORDER WSORT,Z
CSYS,0
WSORT,Z
C*** COUPLING EQUATIONS
C*** BARREL TO MANIFOLDS
CP,1,UX,1C004,1849
,2,UX,10005,1851
,3,UX,10003,1349
,4,UX,100C2,1351
CPL6,1,UY,ROTZ
RP4,1
C*** MANIFOLES TC SHELL
C*** FRONT FACE
CP,21,UZ,79,1389
,22,UZ,76,1388
,23,UZ,69,1392
,24,UZ,59,1394
,25,UZ,61,1398
,26,UZ,54,1386
,27,UZ,49,1376
,28,UZ,44,1364
,29,UZ,39,1356
,30,UZ,29,1325
,31,UZ,21,1396
,32,UZ,14,1322
,33,UZ,9,131E
,34,UZ,2,1311
,35,UZ,1,131C
CPSGEN,2,300C,22,34
CPL6,21,UX,UY
RP28,1
C*** SLOTS
CP,2C1,UX,1891,1116
,202,UX,1889,112C
,203,UX,1814,164
,204,UX,1810,628
C*** VERTICAL PADS
CP,210,UY,1820,381
,211,UY,1818,632
,212,UY,4820,3381
,213,UY,4818,3632
C*** SHELL TC CABLES
CP,221,UX,19,10009,1334
,222,UX,3C19,10012,4334
CPL6,221,UY,UZ
RP2,1
C*** MASTER DOF'S
P,1352,UX,1353,1,UY,UZ
P,1852,UX,1853,1,UY,UZ
```

```
P,4352,UX,4353,1,UY,UZ
P,4852,UX,4853,1,UY,UZ
P,10C01,UX,1CC05,1,UY,UZ
PEEL,10001,UZ
TCTAL,100,1
ITER,1,1,1
PRST,-1,3,7
REF,2
REC,1
D,10001,UZ,0
C*** STATIC FIRING FORCE
F,1353,FZ,0,,4353,3000
F,1352,FY,0,,1353,1
F,1852,FY,0,,1853,1
F,4352,FY,-0,,4353,1
F,4852,FY,-0,,4853,1
DTIME,.001
AFWR
FINI
/PREP6
NTAB,4
NSTEPS,5C0
FILL,1,1,500,1,,.C01,.001
FILL,2,1,12,1,10C0,1000
,2,12,26,1,12000,4500
,2,26,50,1,75000,0
,2,50,60,1,75000,-44C
,2,60,70,1,7C600,-610
,2,70,80,1,64500,-520
,2,80,90,1,55300,-470
,2,90,100,1,54600,-430
,2,100,110,1,50300,-380
,2,110,120,1,465C0,-350
,2,120,130,1,430C0,-3C0
,2,130,14C,1,40000,-280
,2,140,150,1,372C0,-240
,2,150,160,1,348C0,-220
,2,160,170,1,326C0,-180
,2,170,180,1,308C0,-160
,2,180,190,1,292C0,-140
,2,190,200,1,27800,-110
,2,200,210,1,26700,-90
,2,210,220,1,25800,-60
,2,220,230,1,25200,-2520
CCM8,2,2,,,-.5
FILL,3,1,,,2C04
,3,2,,,6496
,3,3,,,18198
,3,4,,,35917
,3,5,,,42167
,3,6,,,33231
,3,7,,,22435
,3,8,,,14898
,3,9,,,10192
,3,10,,,7251
,3,11,,,5353
CCM9,3,3,,,,25   * 8 NODES AT 6 IA.
CCM8,4,3,,,-1
PLVA,2,3
RITTER,,1
NPOST,,1
NPRINT,0
TIME,1
FZ,1353,2
FZ,4353,2
C*** FY,1352,3
```

12

```
C*** FY,4352,4
C*** FY,1353,3
C*** FY,4353,4
C*** FY,1852,3
C*** FY,4852,4
C*** FY,1853,3
C*** FY,4853,4
LFWR,1,500
FINI
/EXEC
/INP,27
/INP,23
FINI
/EOF
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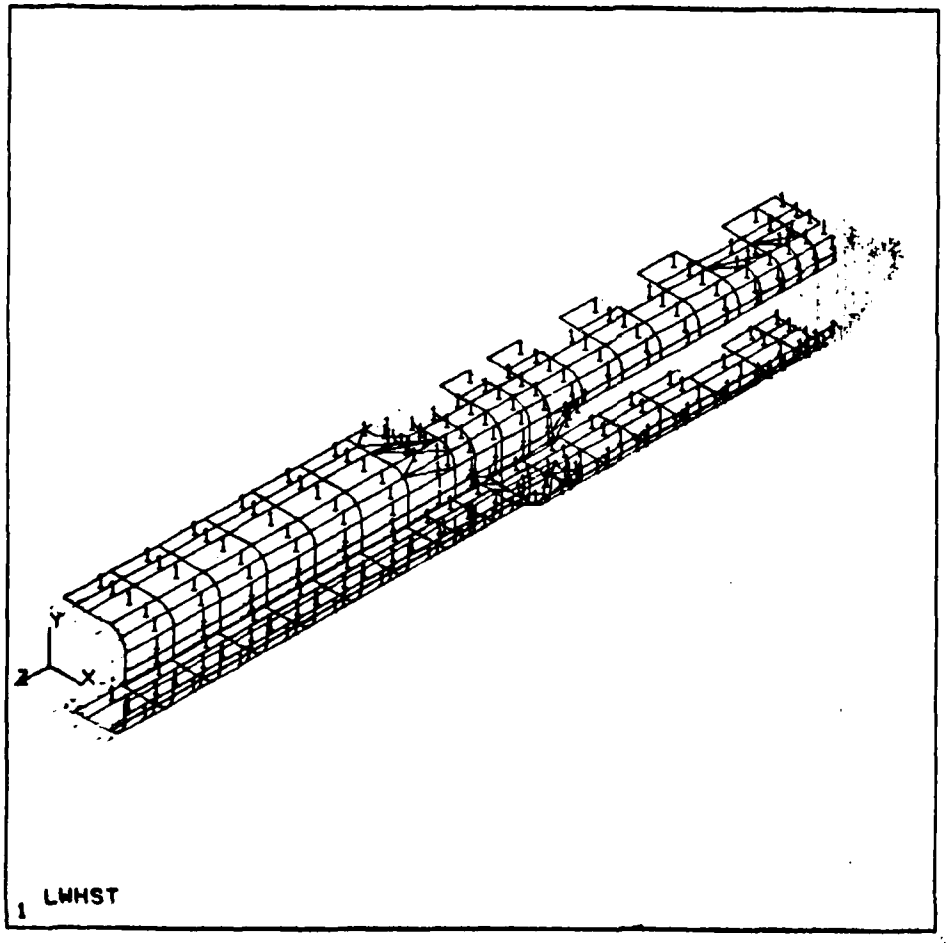
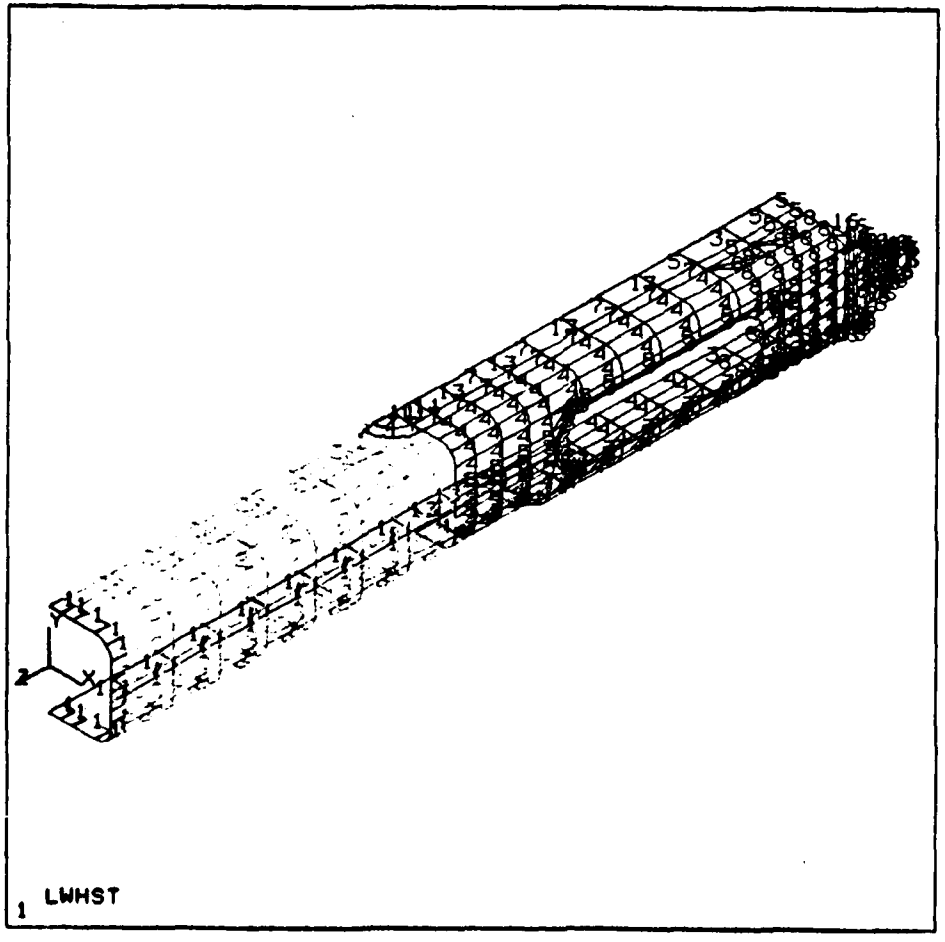
GEOMETRY PLOTS - MODEL 12

Model (12)



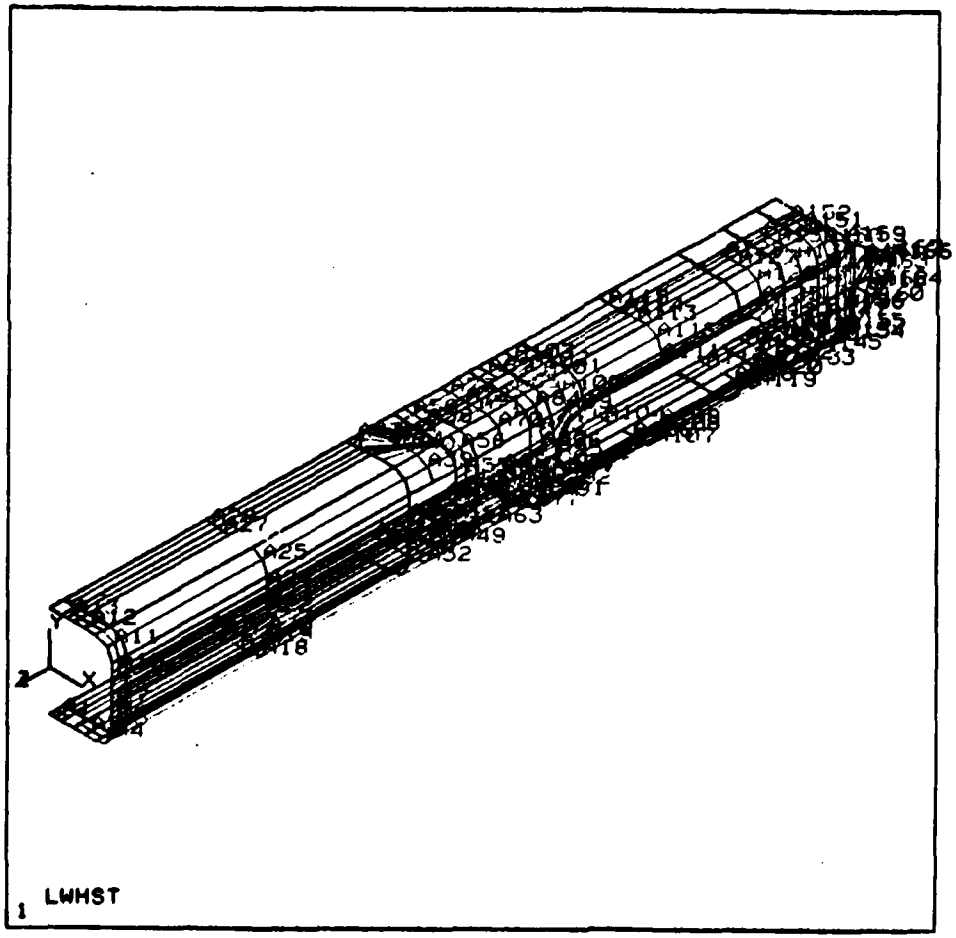
ANSYS 4.2B
FEB 13 1987
7:19:15
PLOT NO. 1
PREP7 ELEMENTS
TNUM=1

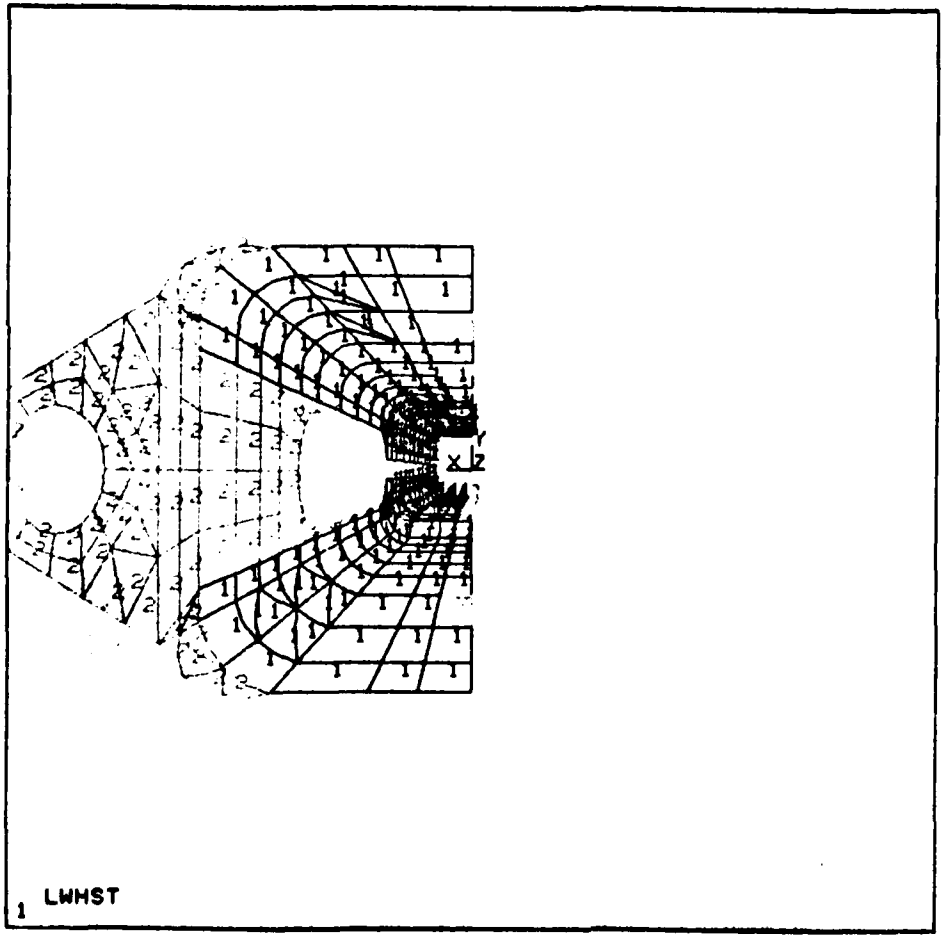
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115



ANSYS 4.2B
FEB 13 1987
7:19:33
PLOT NO. 2
PREP7 ELEMENTS
RNUM=1

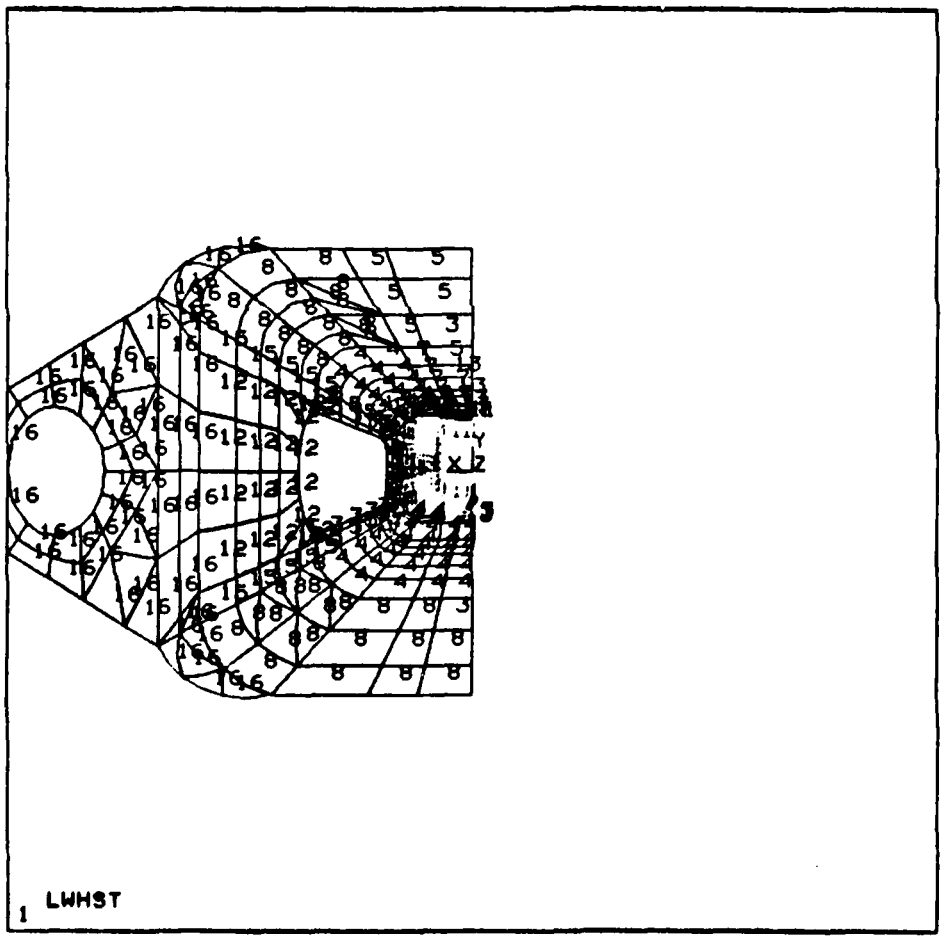
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115


ANSYS 4.2B
FEB 13 1987
7:19:49
PLOT NO. 3
PREP7 AREAS
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.33
ZF=-116
LWHST



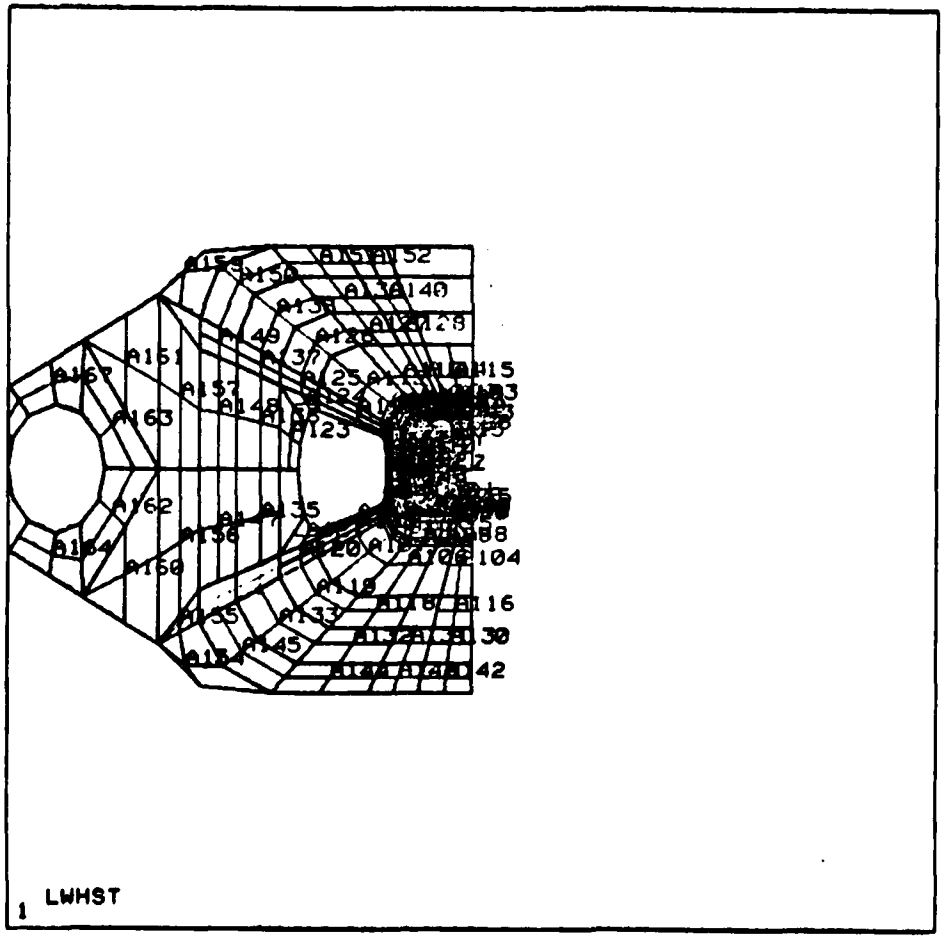
ANSYS 4.2B
FEB 13 1987
7:20:21
PLOT NO. 4
PREP7 ELEMENTS
TNUM=1

ZV=-1
* DIST=139
* ZF=-119
CONE=40



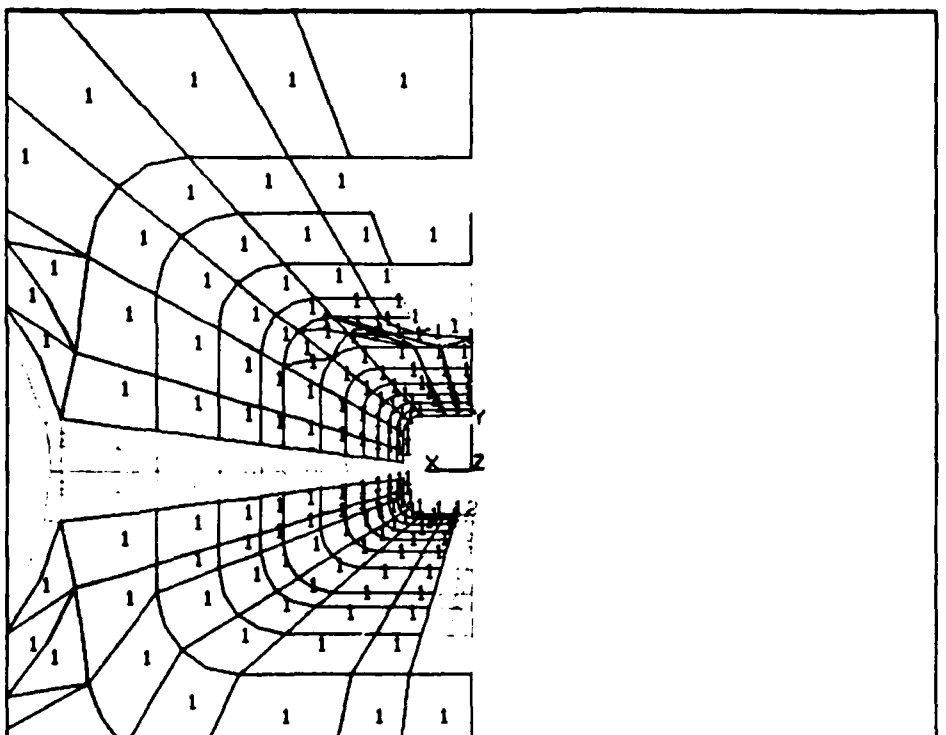
ANSYS 4.2B
FEB 13 1987
7:20:37
PLOT NO. 5
PREP7 ELEMENTS
RNUM=1

ZV=-1
* DIST=139
* ZF=-119
CONE=40



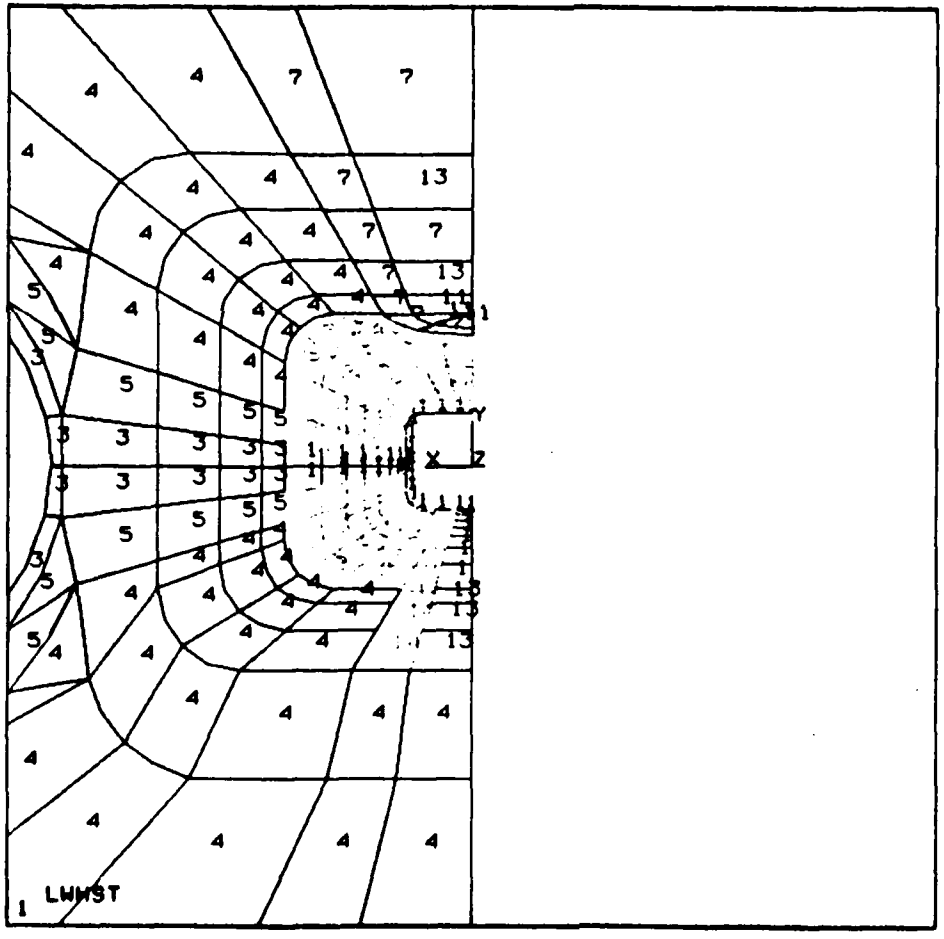
ANSYS 4.2B
FEB 13 1987
7:20:53
PLOT NO. 6
PREP7 AREAS

ZV=-1
* DIST=130
* ZF=-118
CONE=40



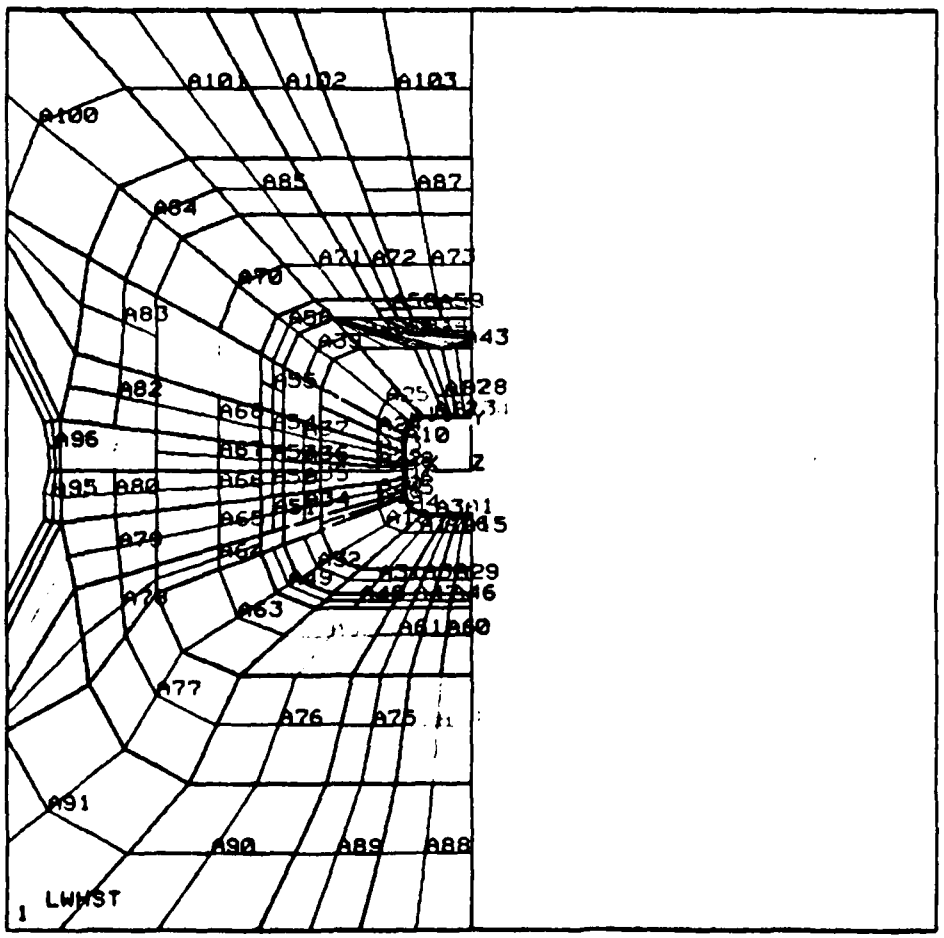
ANSYS 4.2B
FEB 13 1987
7:21:24
PLOT NO. 7
PREP7 ELEMENTS
TNUM=1

ZV=-1
* DIST=160
CONE=40



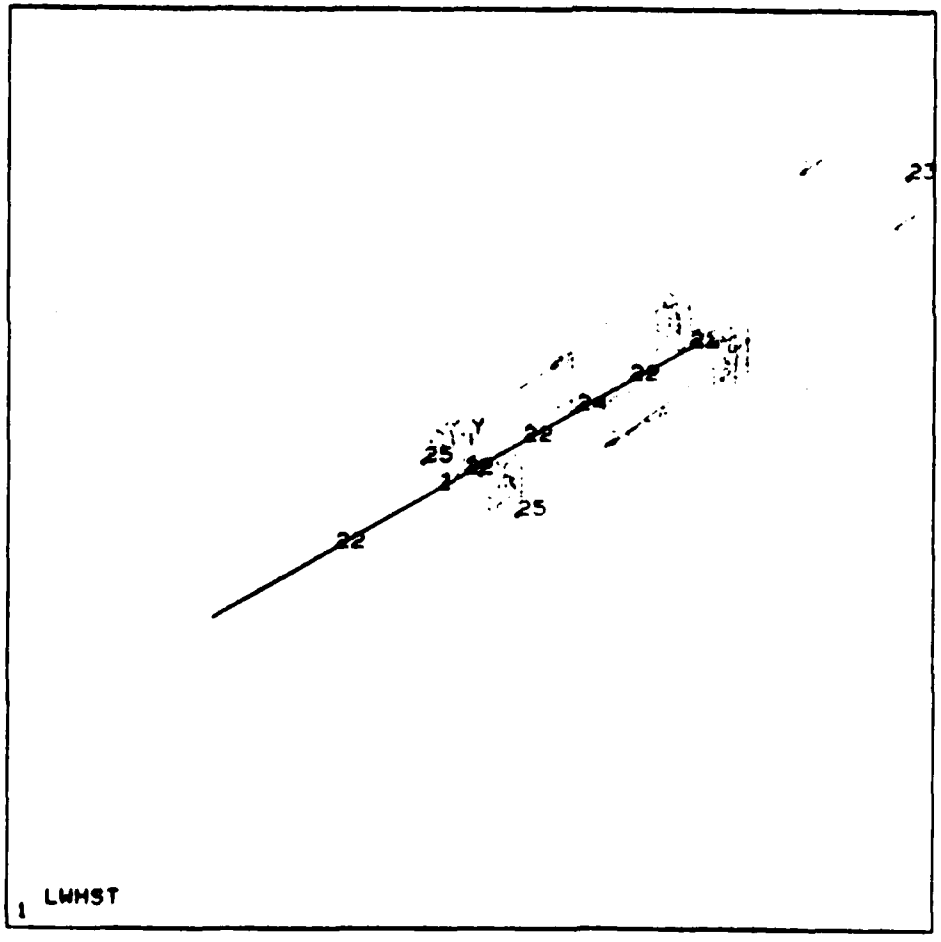
ANSYS 4.2B
FEB 13 1987
7:21:35
PLOT NO. 8
PREP7 ELEMENTS
RNUM=1

ZV=-1
* DIST=160
CONE=40



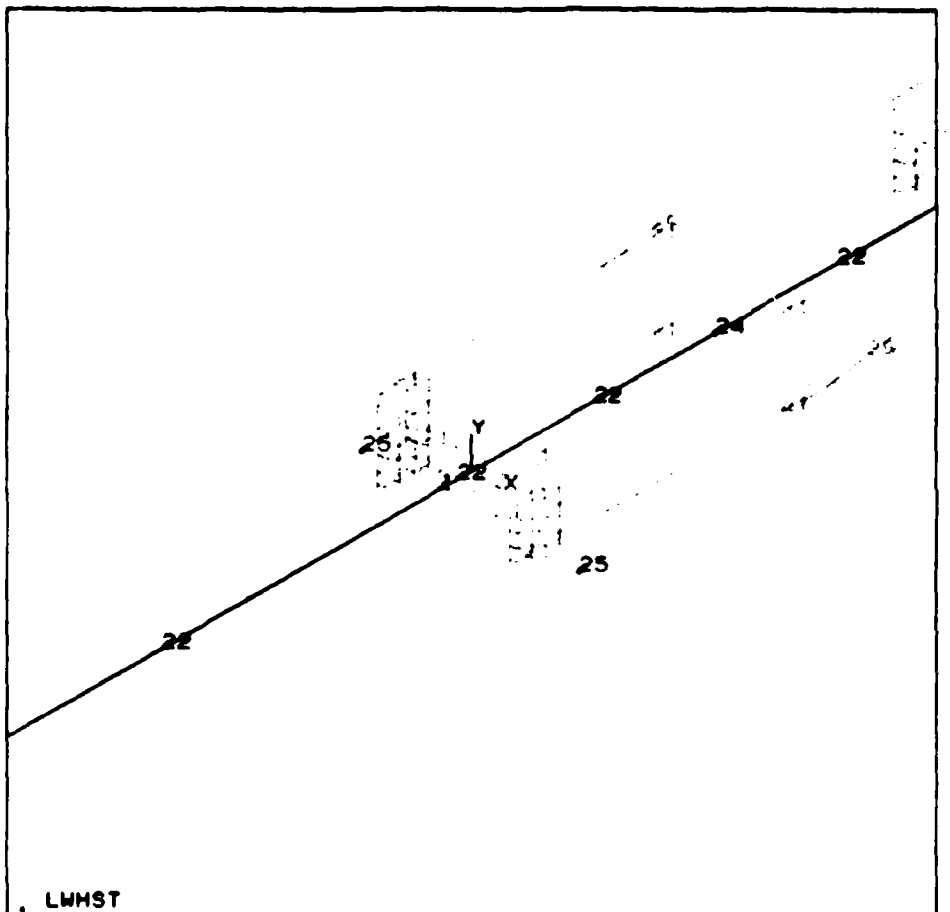
ANSYS 4.2B
FEB 13 1987
7:21:44
PLOT NO. 9
PREP7 AREAS

ZV=-1
# DIST=160
CONE=40



ANSYS 4.2B
FEB 13 1987
7:22:08
PLOT NO. 10
PREP7 ELEMENTS
RNUM=1

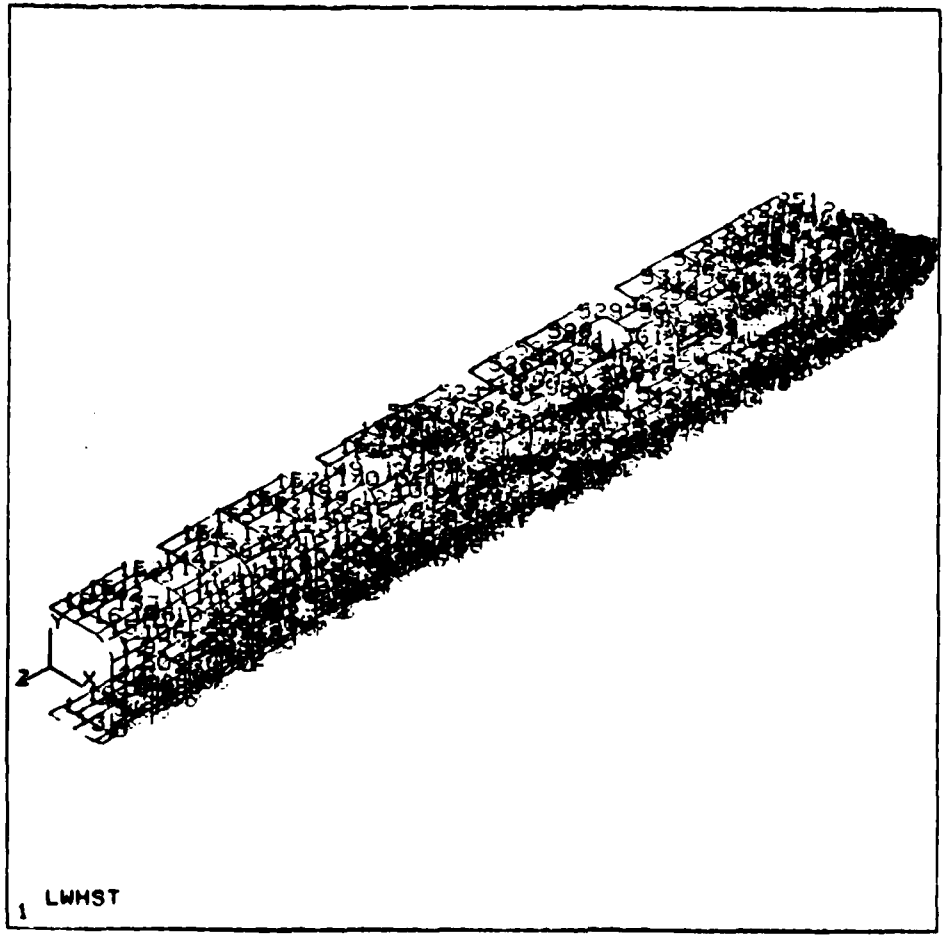
XV=1
YV=1
ZV=1
DIST=160



ANSYS 4.2B
FEB 13 1987
7:22:08
PLOT NO. 10
PREP7 ELEMENTS
RNUM=1

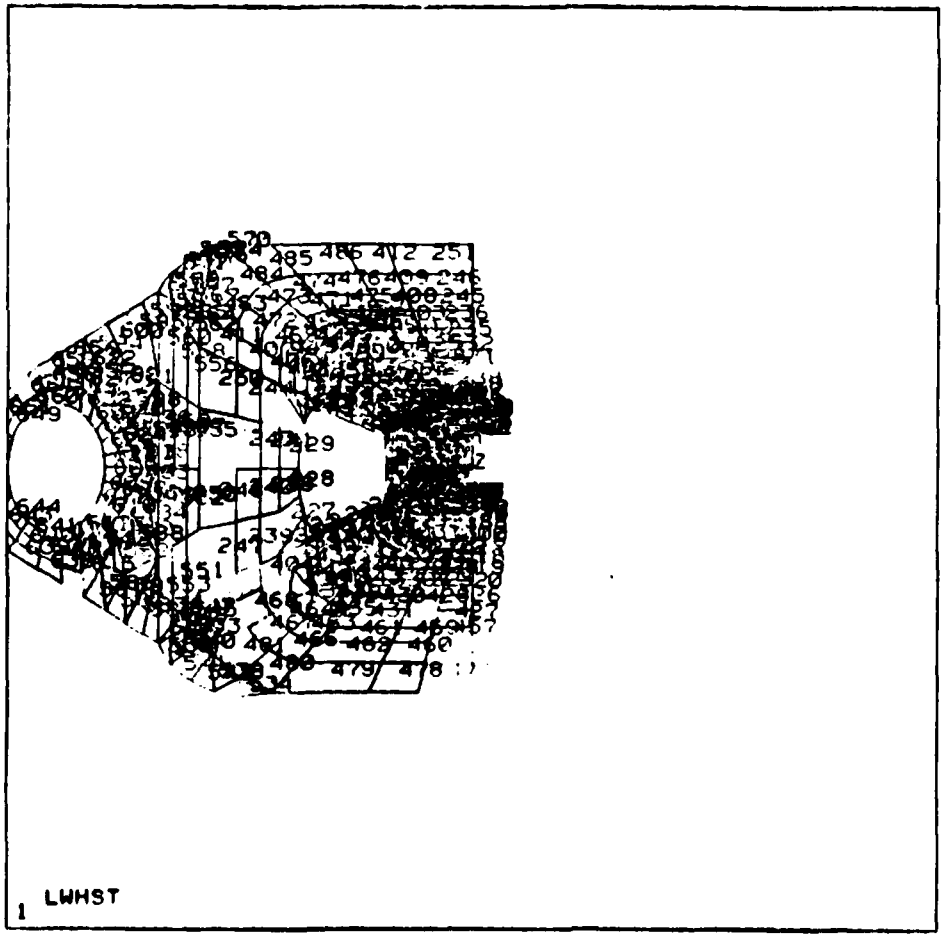
XV=1
YV=1
ZV=1
* DIST=70

Model (11)



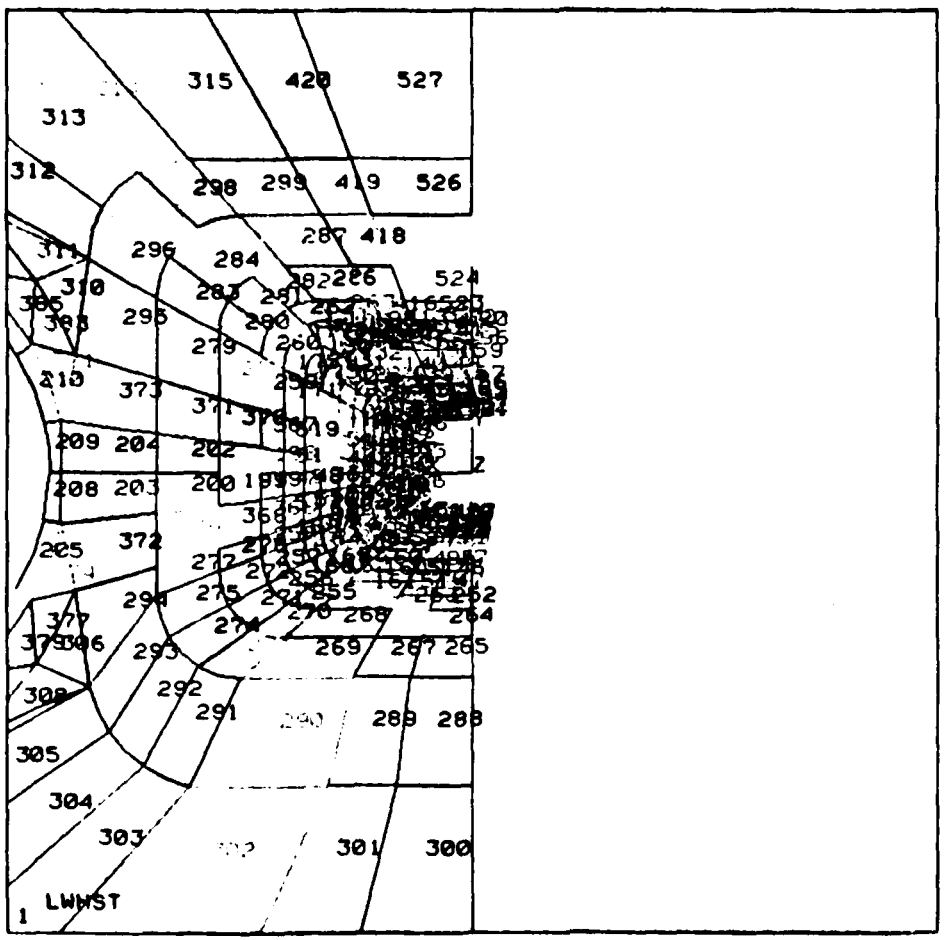
ANSYS 4.2B
FEB 14 1987
16:12:28
PLOT NO. 1
PREP7 ELEMENTS
ENUM=1

XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115



ANSYS 4.2B
FEB 14 1987
16:13:03
PLOT NO. 2
PREP7 ELEMENTS
ENUM=1

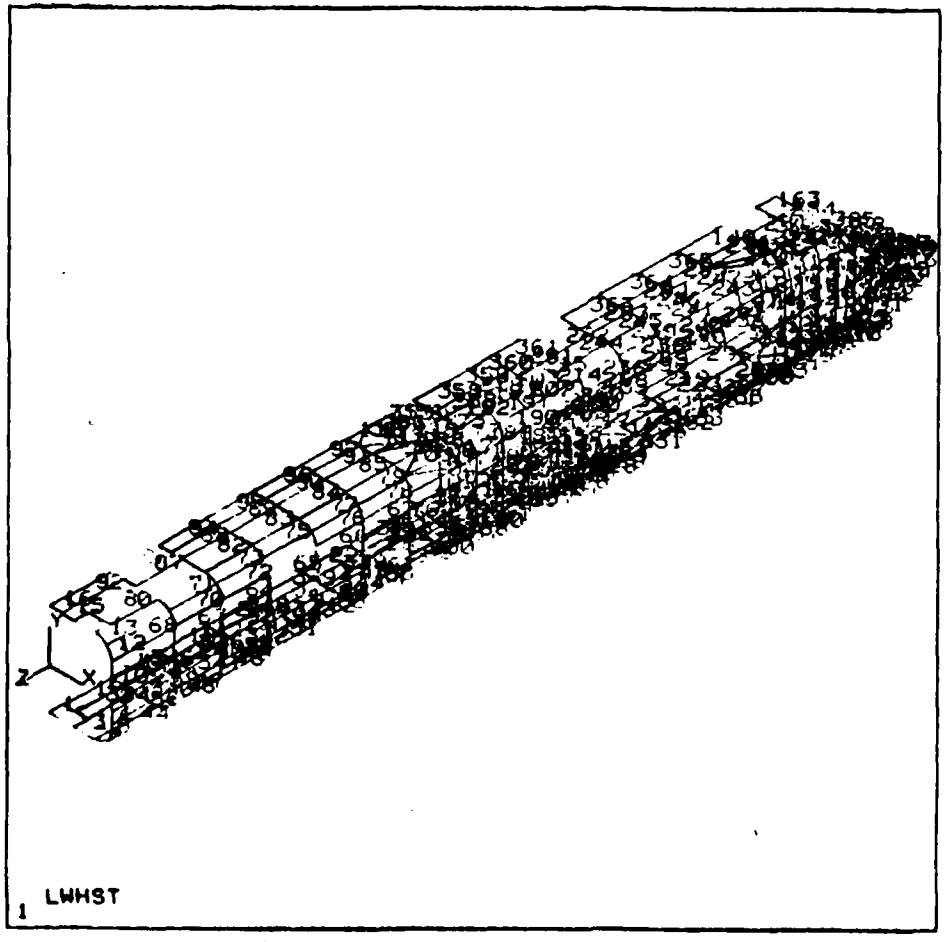
ZV=-1
* DIST=139
* ZF=-119
CONE=40



ANSYS 4.2B
FEB 14 1987
16:14:13
PLOT NO. 3
PREP7 ELEMENTS
ENUM=1

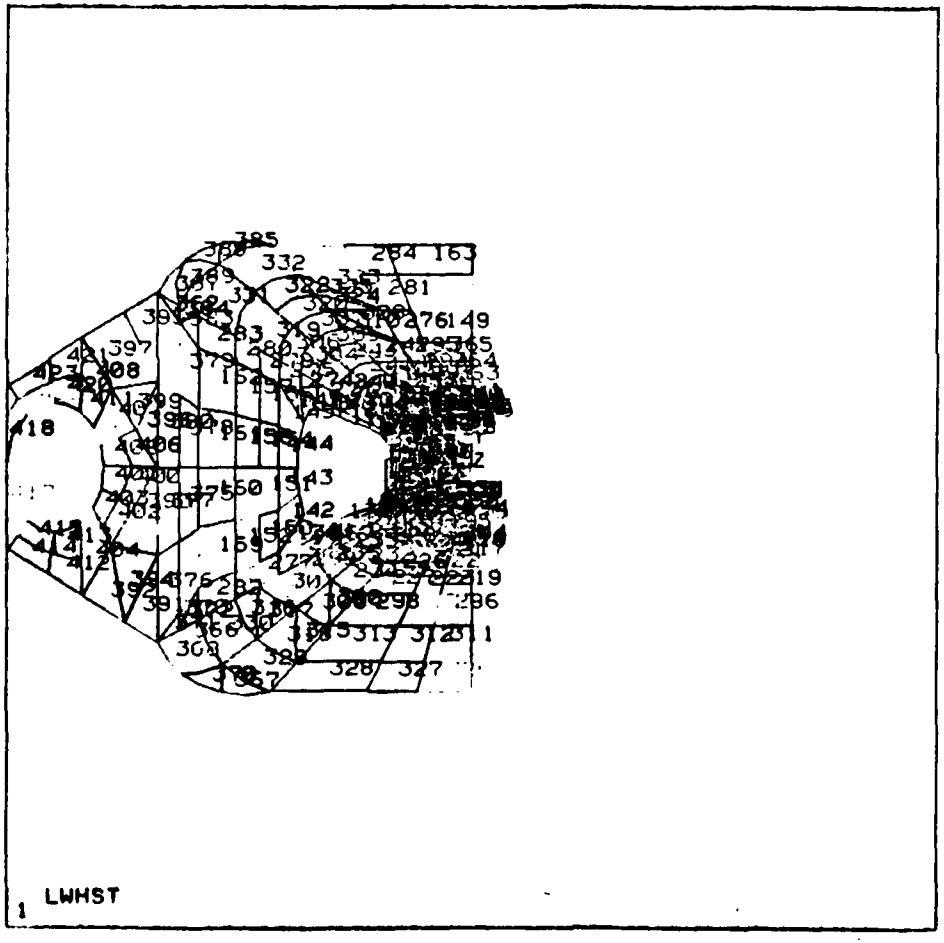
ZV=-1
* DIST=160
CONE=40

(12.)



ANSYS 4.2B
FEB 14 1987
17:02:23
PLOT NO. 1
PREP7 ELEMENTS
ENUM=1

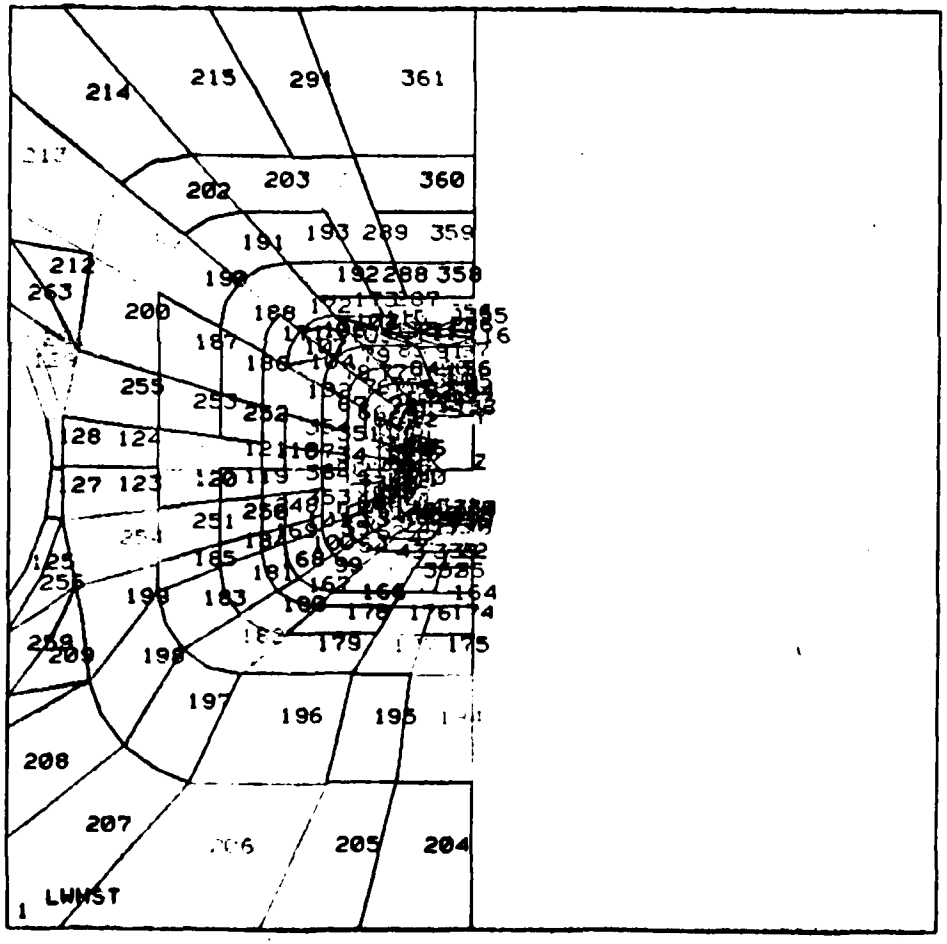
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115



ANSYS 4.2B
FEB 14 1987
17:02:58
PLOT NO. 2
PREP7 ELEMENTS
ENUM=1

ZV=-1
* DIST=139
* ZF=-119
CONE=40

(12)



ANSYS 4.2B
FEB 14 1987
17:03:30
PLOT NO. 3
PREP7 ELEMENTS
ENUM=1

ZV=-1
# DIST=160
CONE=40

D2/310

MCR MEMO: FEBRUARY 14, 1987

2

February 14, 1987

Larry Libhardt
FMC Corporation
3989 Central Ave NE
Minneapolis, Mn 55421

Model 12
static

Dear Larry,

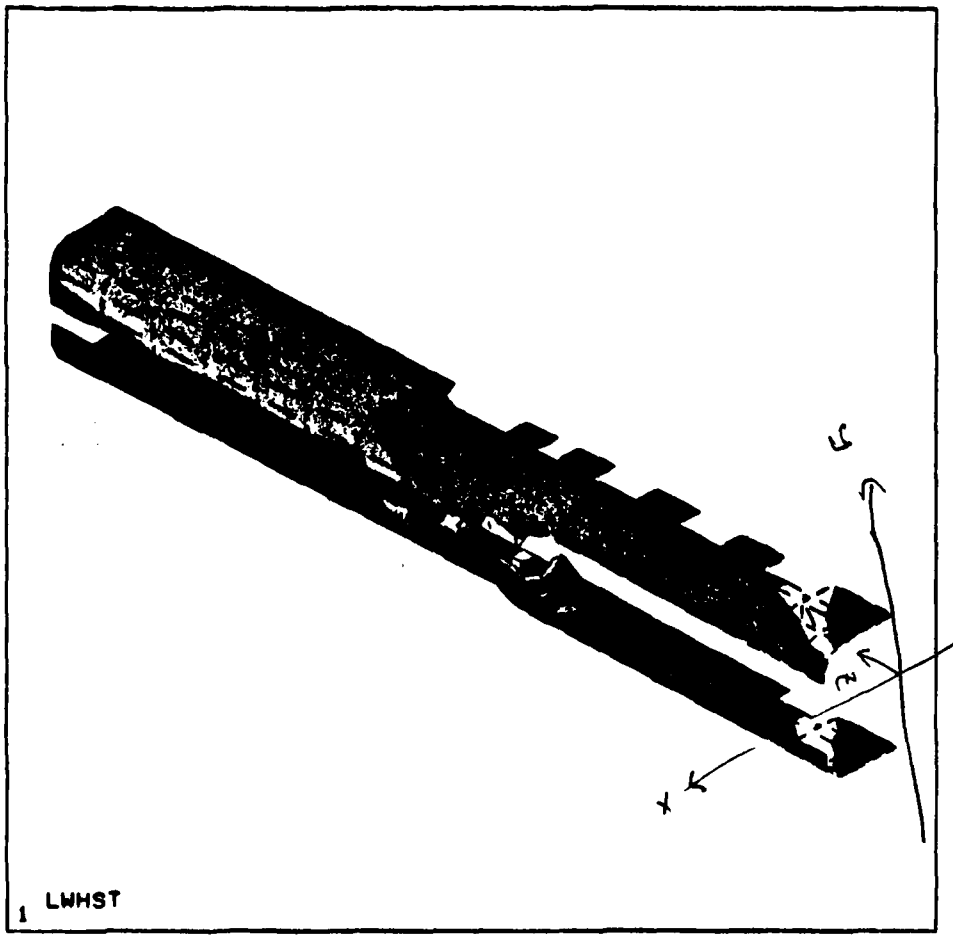
Enlcosed are the results for model 12. We made the thickness changes as requested. The buckling analysis is running at this time but will not be finished before I depart. The plots are not labeled but the numbers showing the plot number on the right hand side are virtually the same as before except we added the SXY values. I have also included plots which show the REAL #'s and element numbers for model 12. The model 11 transient model was identical.

Aloha,

Mark C. Rodamaker

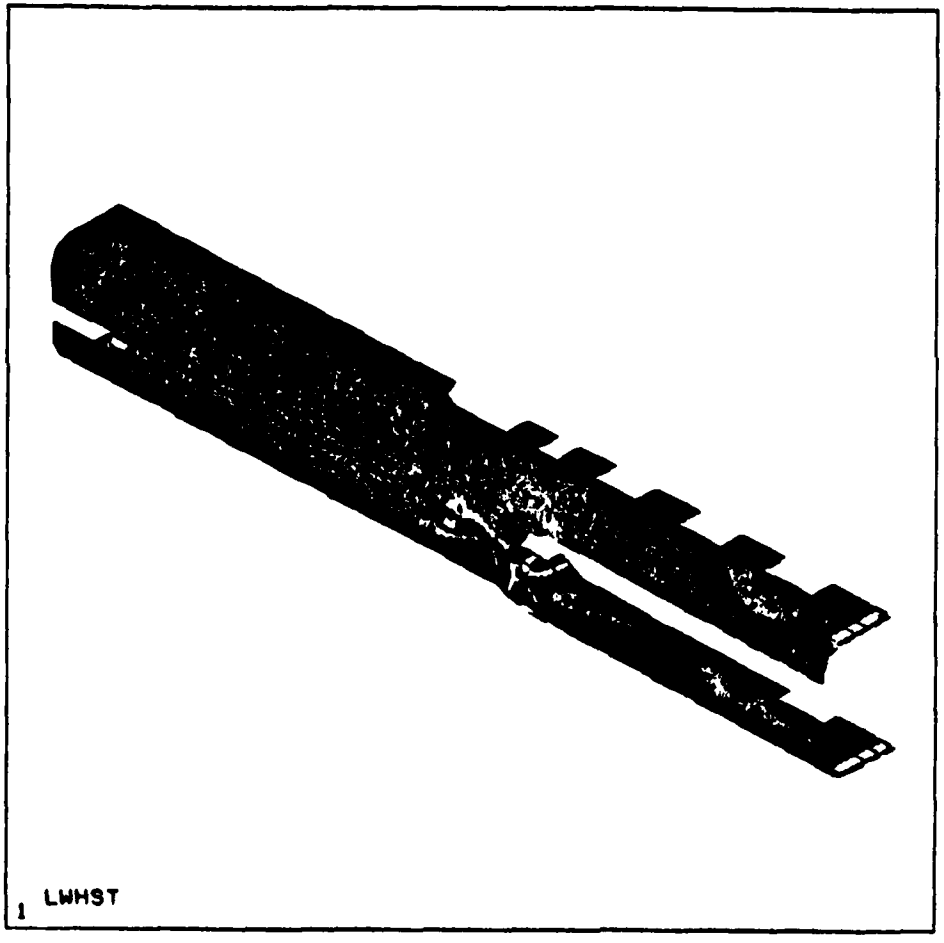
Mark Rodamaker

Model (12)



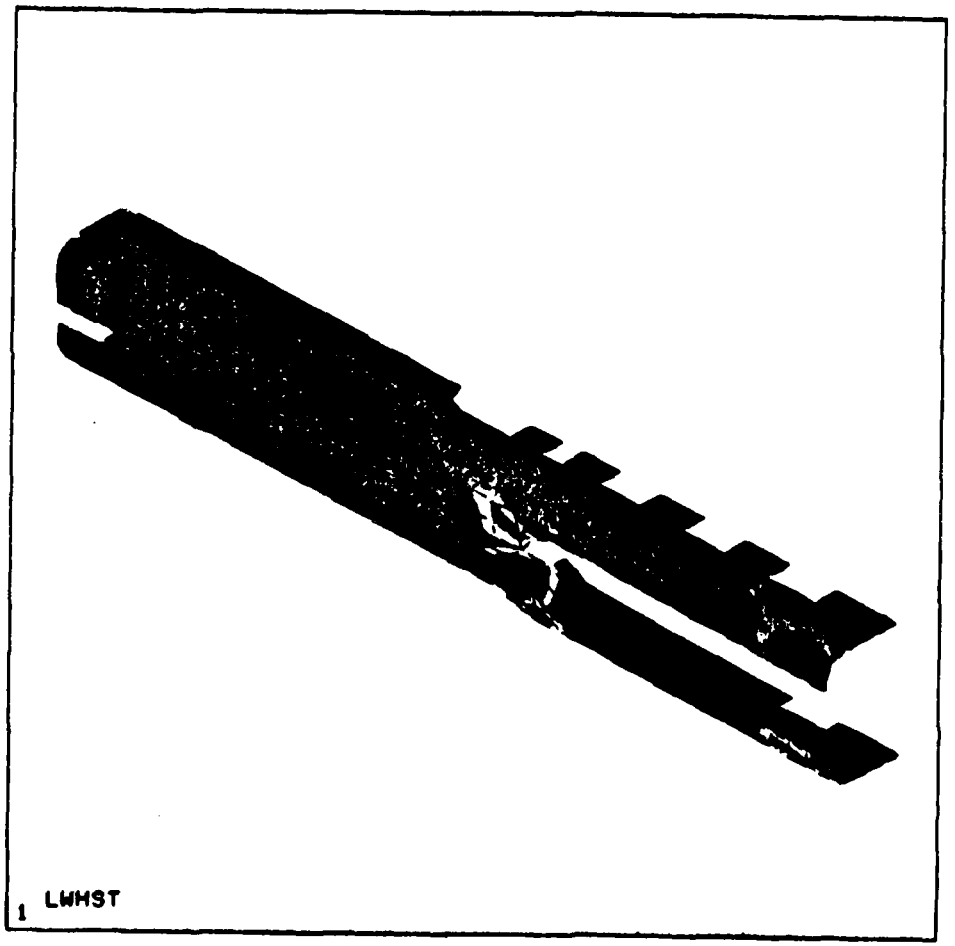
ANSYS 4.2B
FEB 14 1987
13:54:06
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=2550
MN=-11340
-9799
-8255
-6711
-5167
-3623



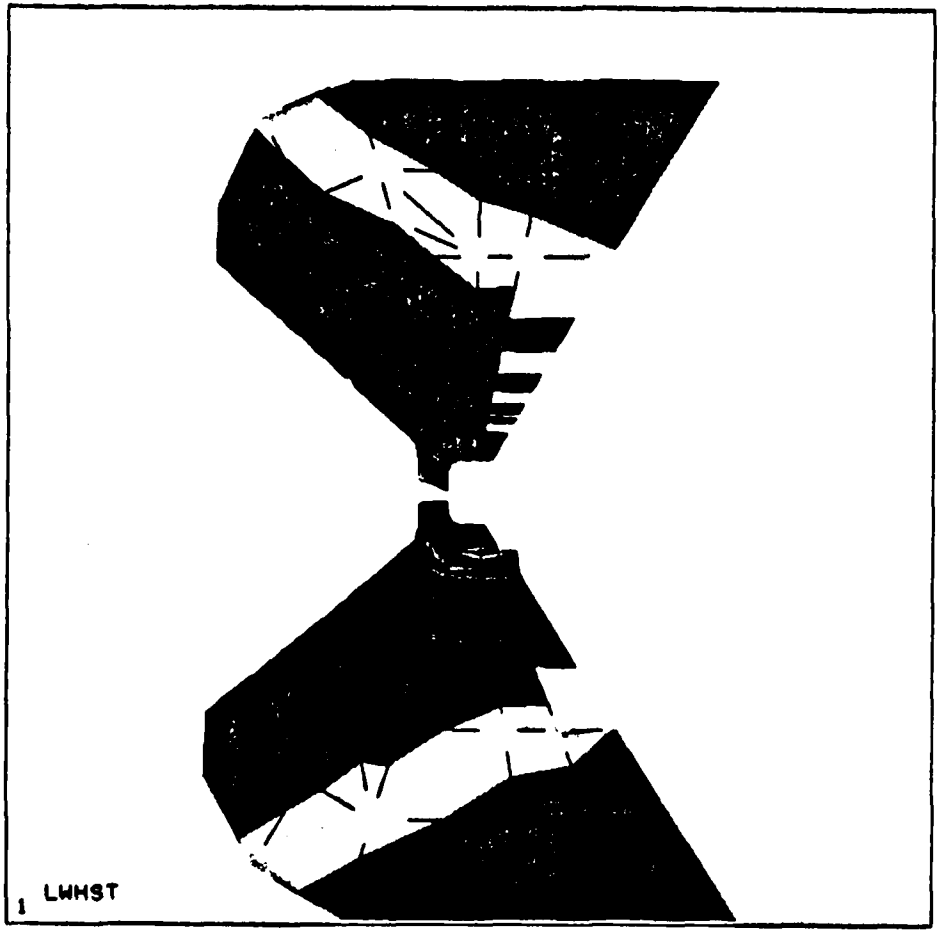
ANSYS 4.2B
FEB 14 1987
13:54:42
PLOT NO. 2
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=5132
MN=-3362
-2419
-1475
-531
413
1357



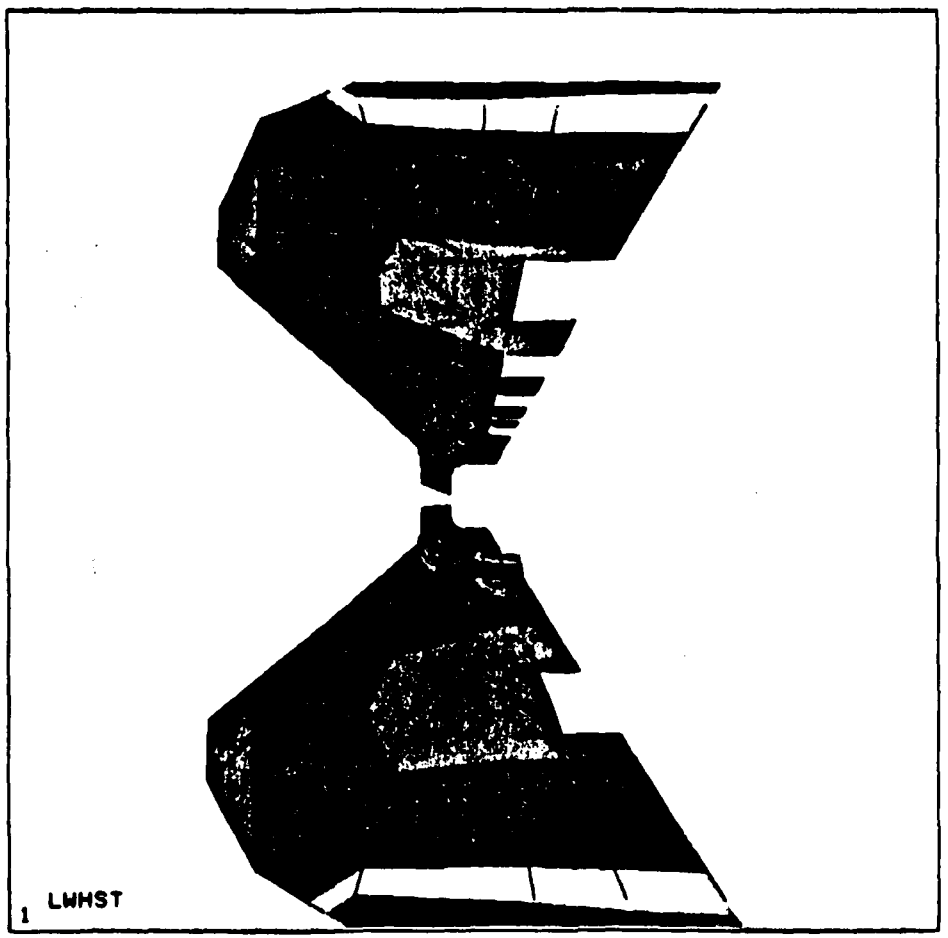
ANSYS 4.2B
FEB 14 1987
13:55:14
PLOT NO. 3
POST1 STRESS
STEP=1
ITER=1
SXY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=2301
MN=-2139
-1648
-1154
-660
-166
328



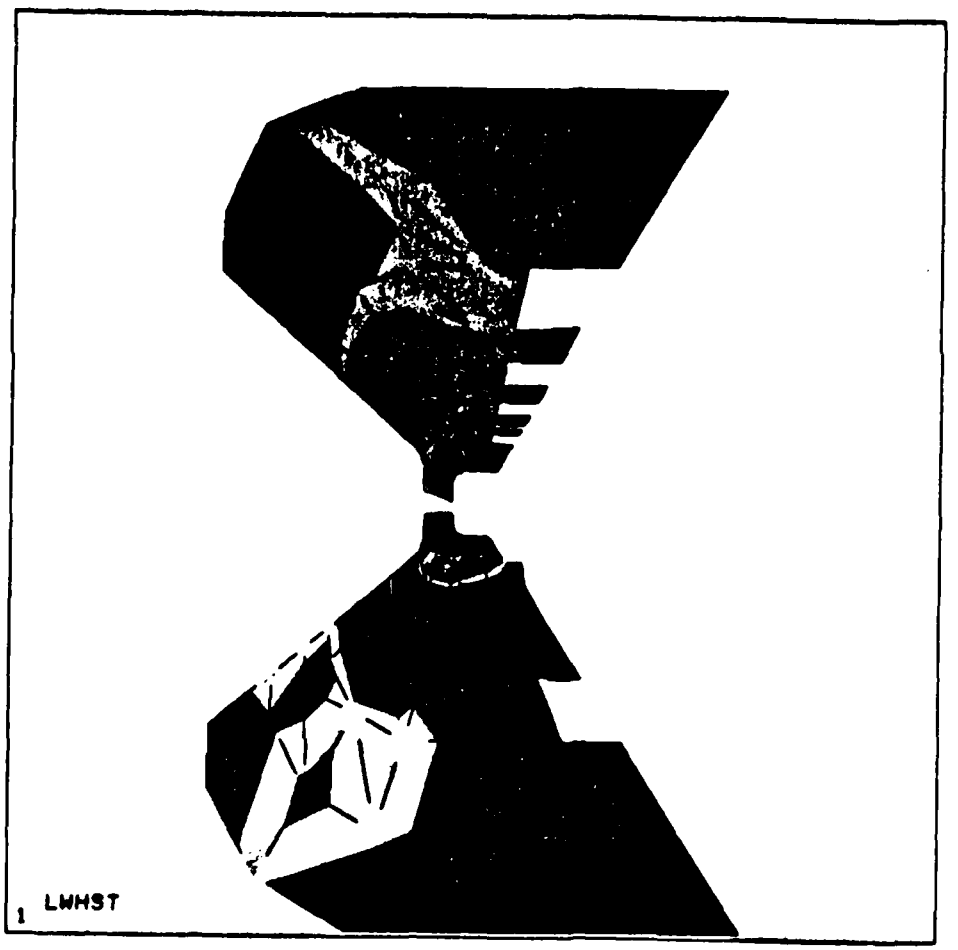
ANSYS 4.2B
FEB 14 1987
13:55:47
PLOT NO. 4
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=2550
MN=-11340
-9799
-8255
-6711
-5167
-3623
.
.
.
1009
2553



ANSYS 4.2B
FEB 14 1987
13:56:19
PLOT NO. 5
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

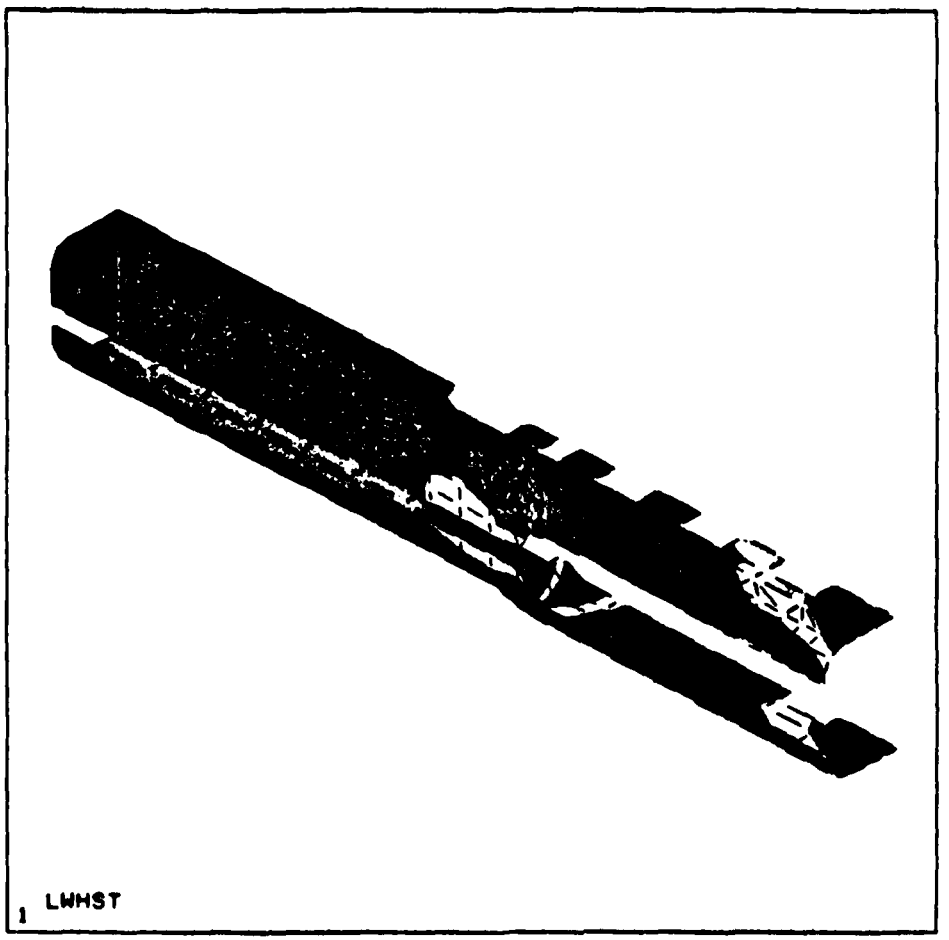
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=5132
MN=-3362
-2419
-1475
-531
413
1357
4189
5133



ANSYS 4.2B
FEB 14 1987
13:56:52
PLOT NO. 6
POST1 STRESS
STEP=1
ITER=1
SXY
TOP
STRESS ELEM CS

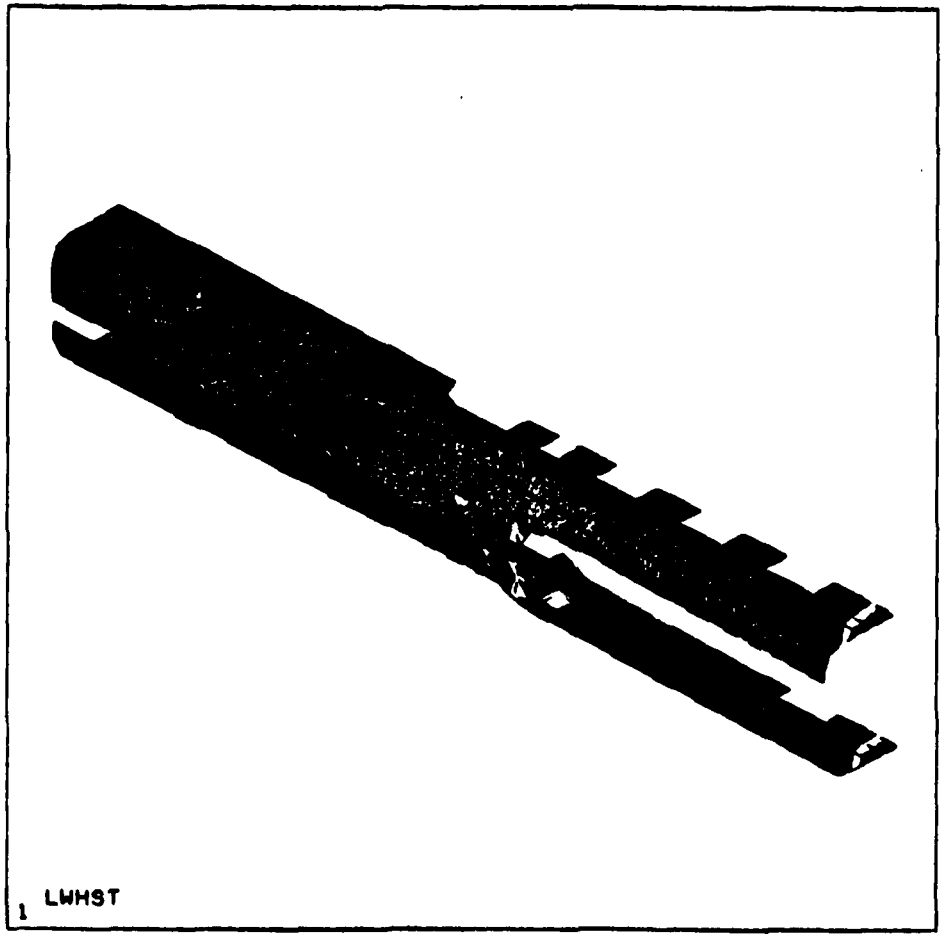
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=2301
MN=-2139
-1648
-1154
-660
-166
328

1810
2304



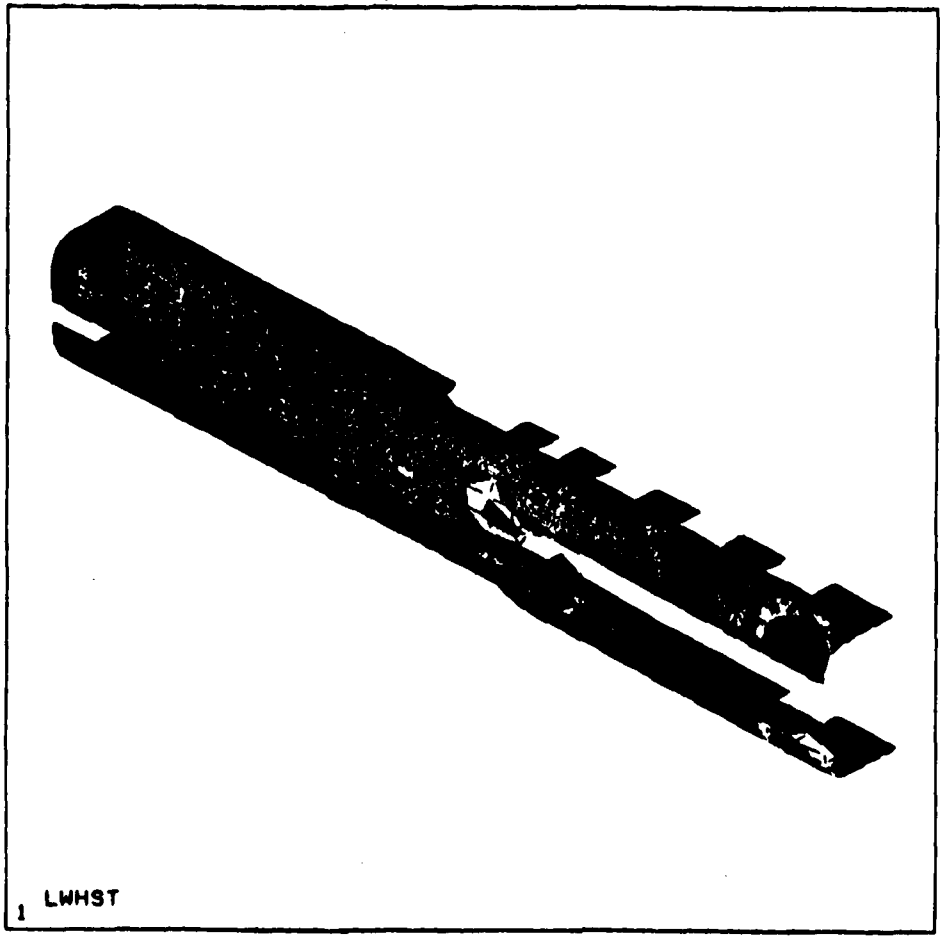
ANSYS 4.2B
FEB 14 1987
13:57:49
PLOT NO. 7
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=2573
MN=-14456
-12567
-10674
-8781
-6888
-4995



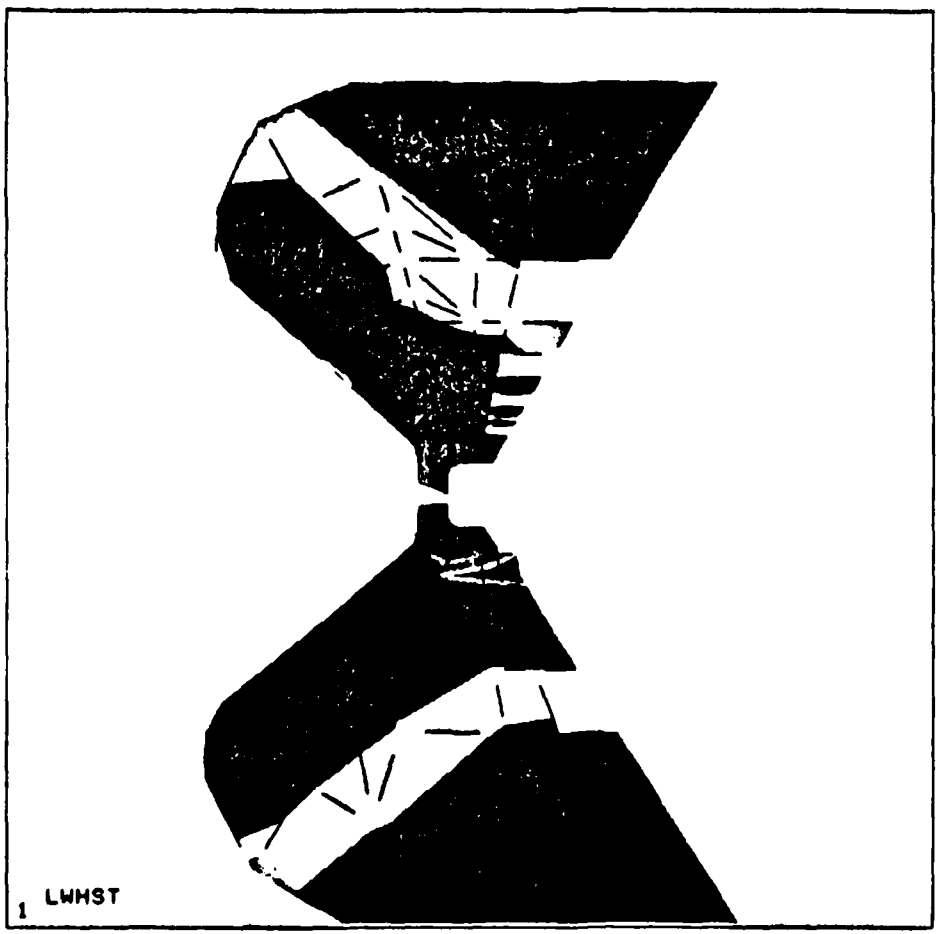
ANSYS 4.2B
FEB 14 1987
13:58:21
PLOT NO. 8
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=3700
MN=-3267
-2496
-1721
-946
-171
604



ANSYS 4.2B
FEB 14 1987
13:58:52
PLOT NO. 9
POST1 STRESS
STEP=1
ITER=1
SXY
BOTTOM
STRESS ELEM CS

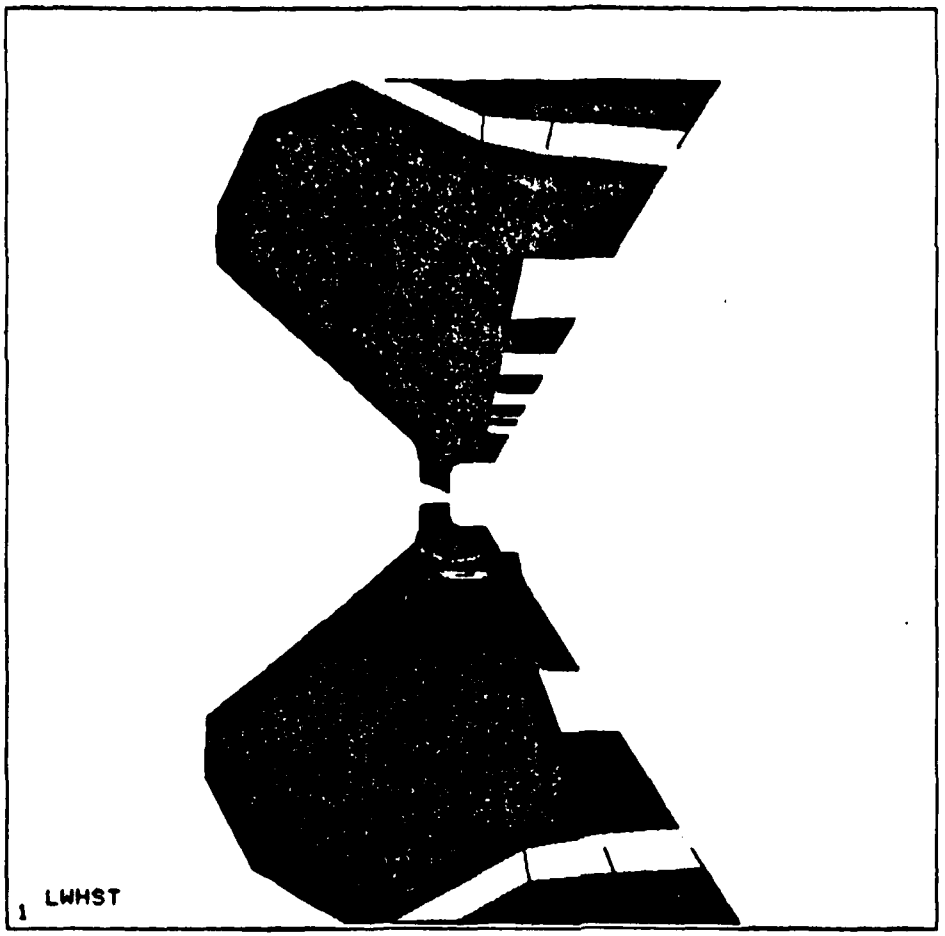
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=3351
MN=-3014
-2310
-1602
-894
-186
522



ANSYS 4.2B
FEB 14 1987
13:59:24
PLOT NO. 10
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

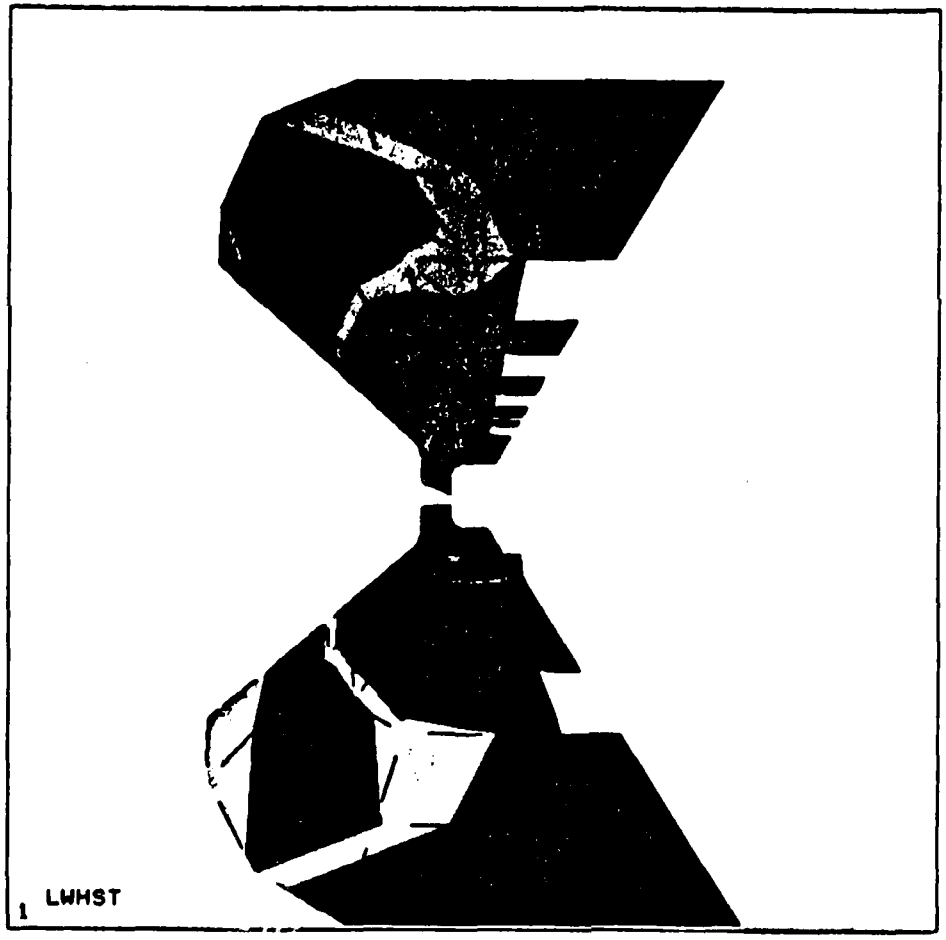
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=2573
MN=-14456
-12567
-10674
-8781
-6888
-4995

684
2577



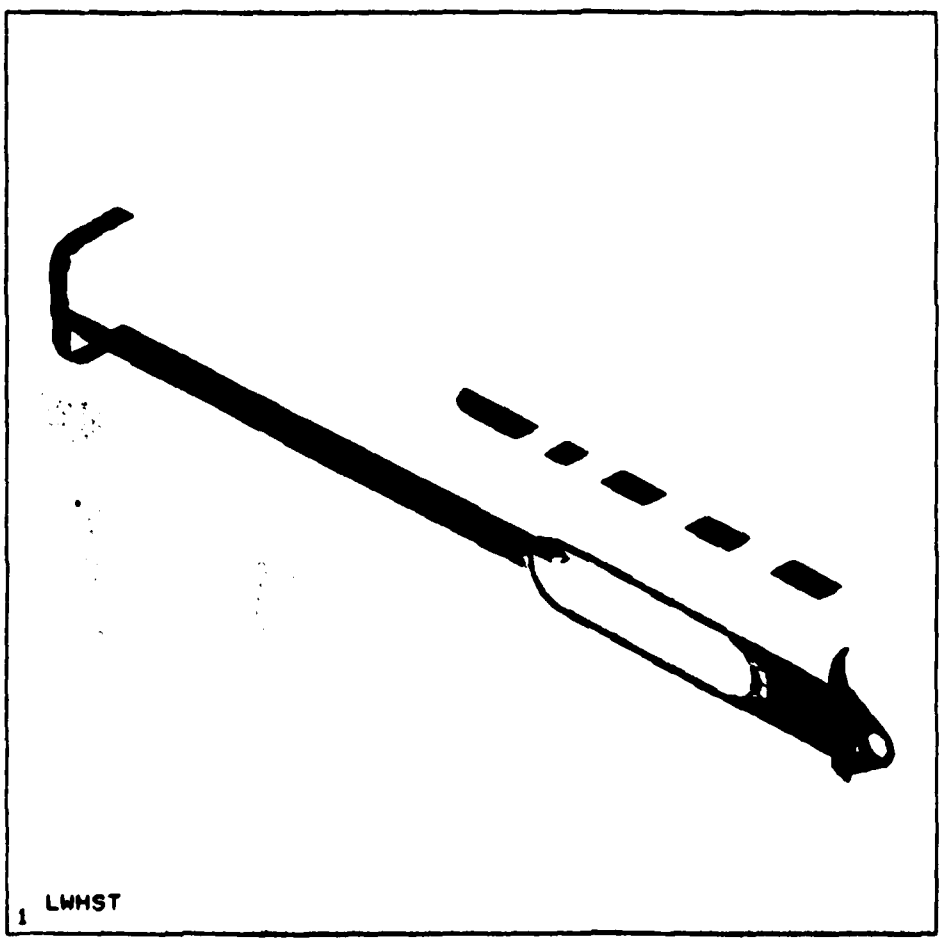
ANSYS 4.2B
FEB 14 1987
13:59:57
PLOT NO. 11
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=3700
MN=-3267
-2496
-1721
-946
-171
604
1379
2929
3704



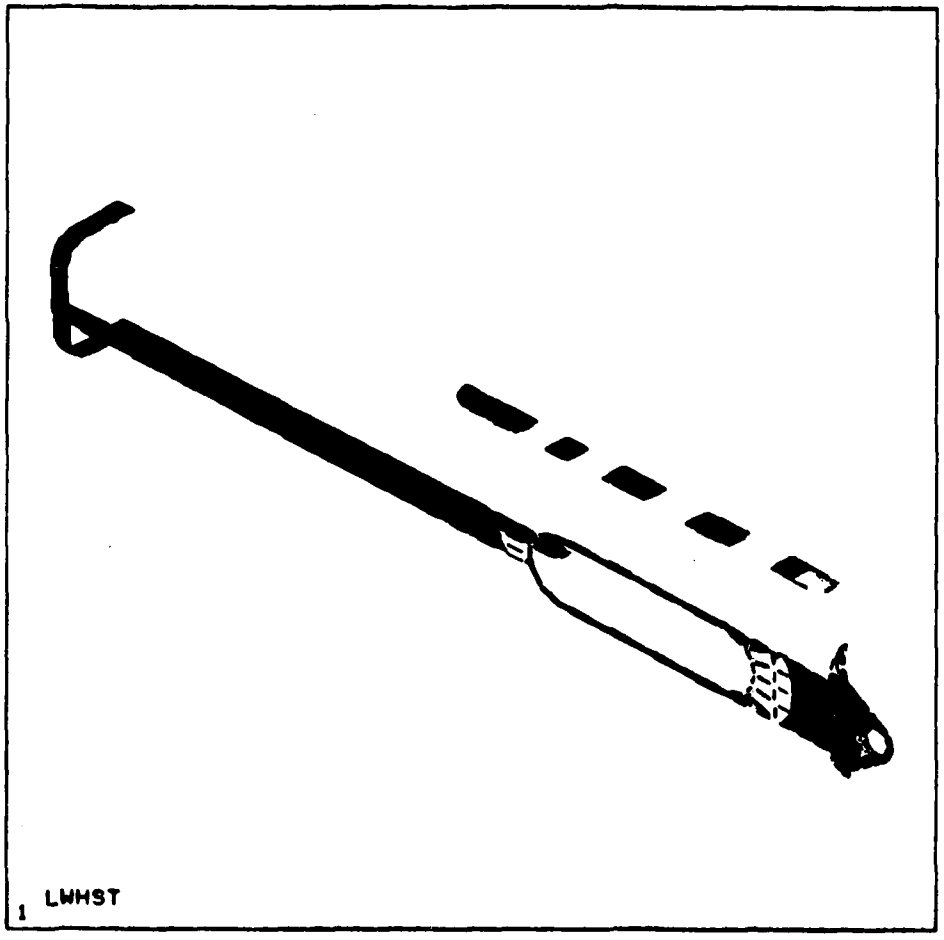
ANSYS 4.2B
FEB 14 1987
14:00:29
PLOT NO. 12
POST1 STRESS
STEP=1
ITER=1
SXY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=3351
MN=-3014
-2310
-1602
-894
-186
522
2646
3354



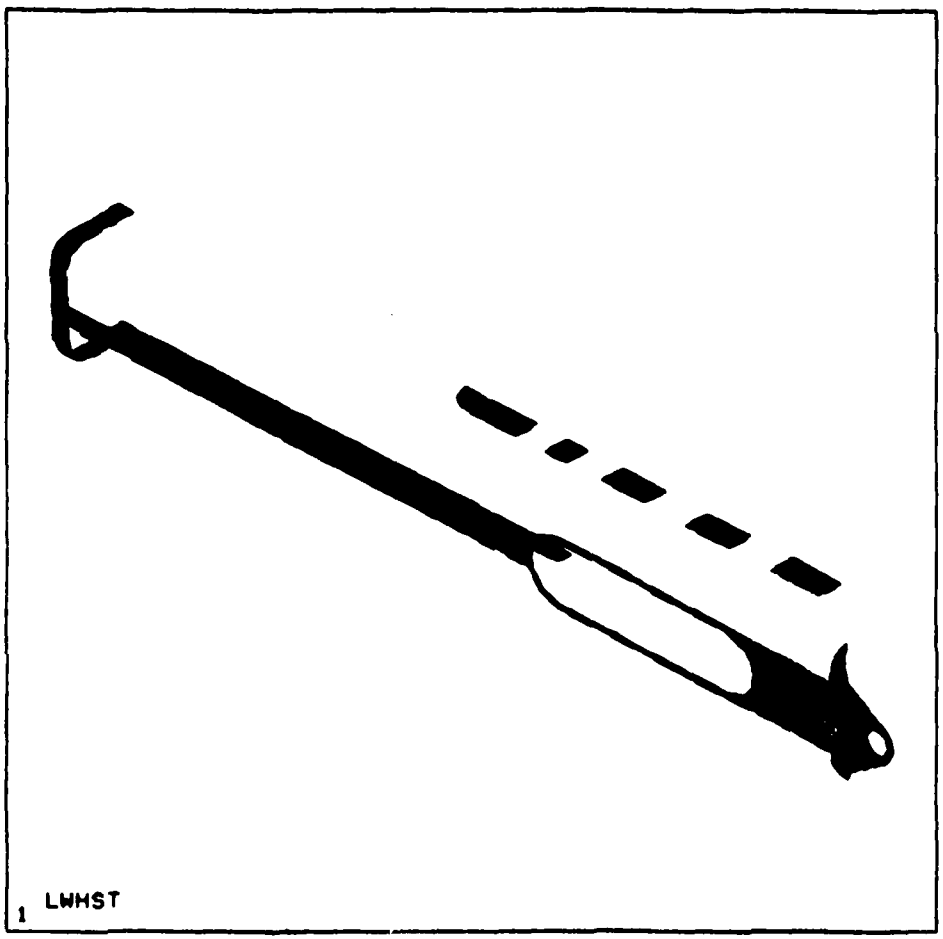
ANSYS 4.2B
FEB 14 1987
14:01:34
PLOT NO. 13
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=6754
MN=-6004
-4588
-3170
-1752
-334
1084
2501
3919



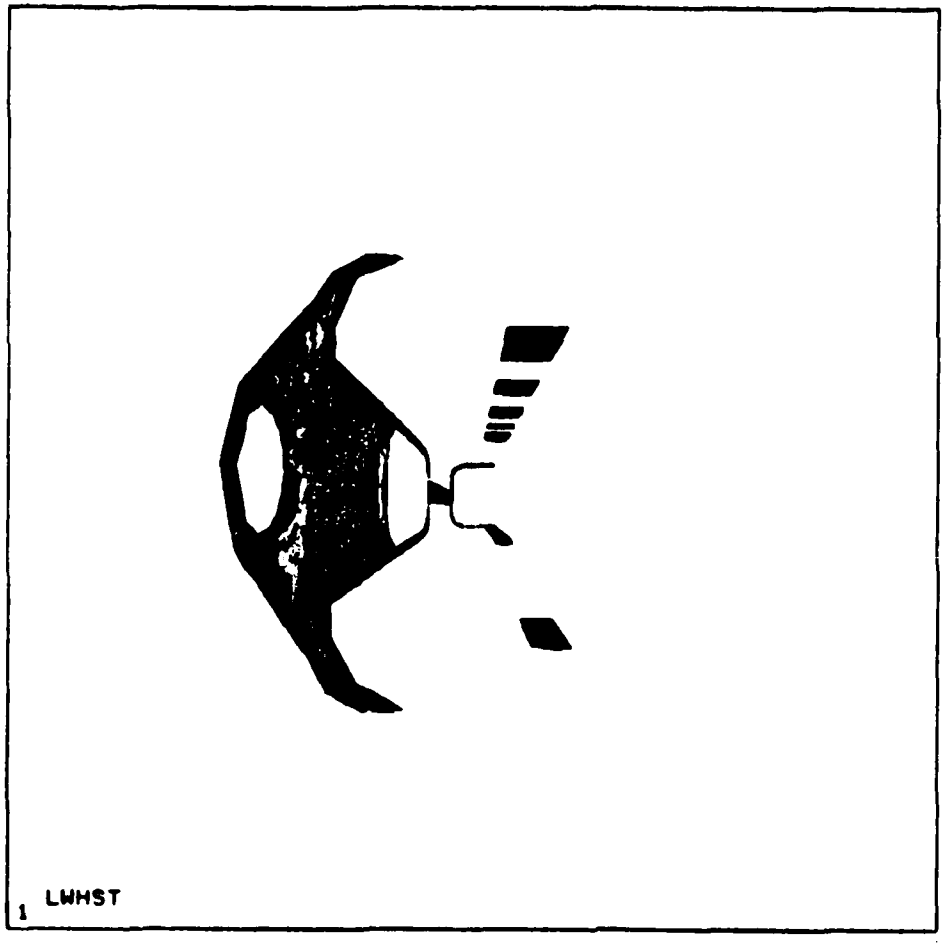
ANSYS 4.2B
FEB 14 1987
14:01:53
PLOT NO. 14
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=6593
MN=-18544
-15751
-12958
-10165
-7372
-4579



ANSYS 4.2B
FEB 14 1987
14:02:10
PLOT NO. 15
POST1 STRESS
STEP=1
ITER=1
SXY
TOP
STRESS ELEM CS

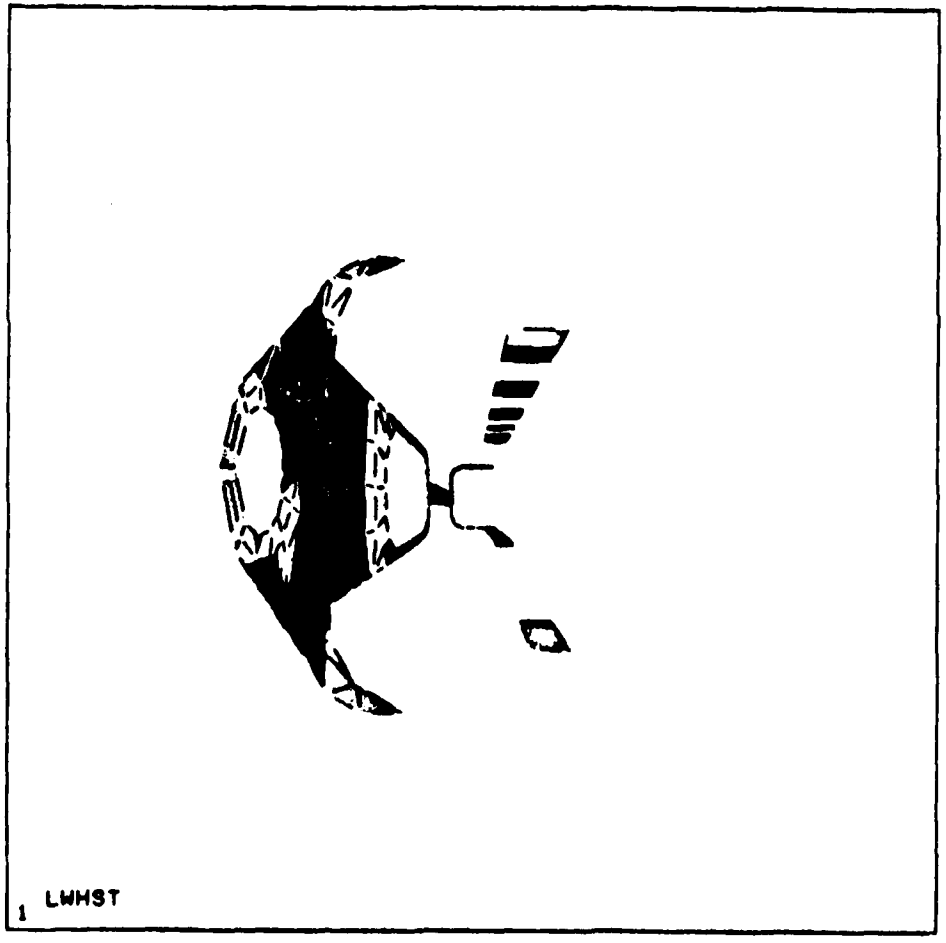
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=11738
MN=-13946
-11093
-8239
-5385
-2531
323



ANSYS 4.2B
FEB 14 1987
14:02:27
PLOT NO. 16
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=6754
MN=-6004
-4588
-3170
-1752
-334
1084

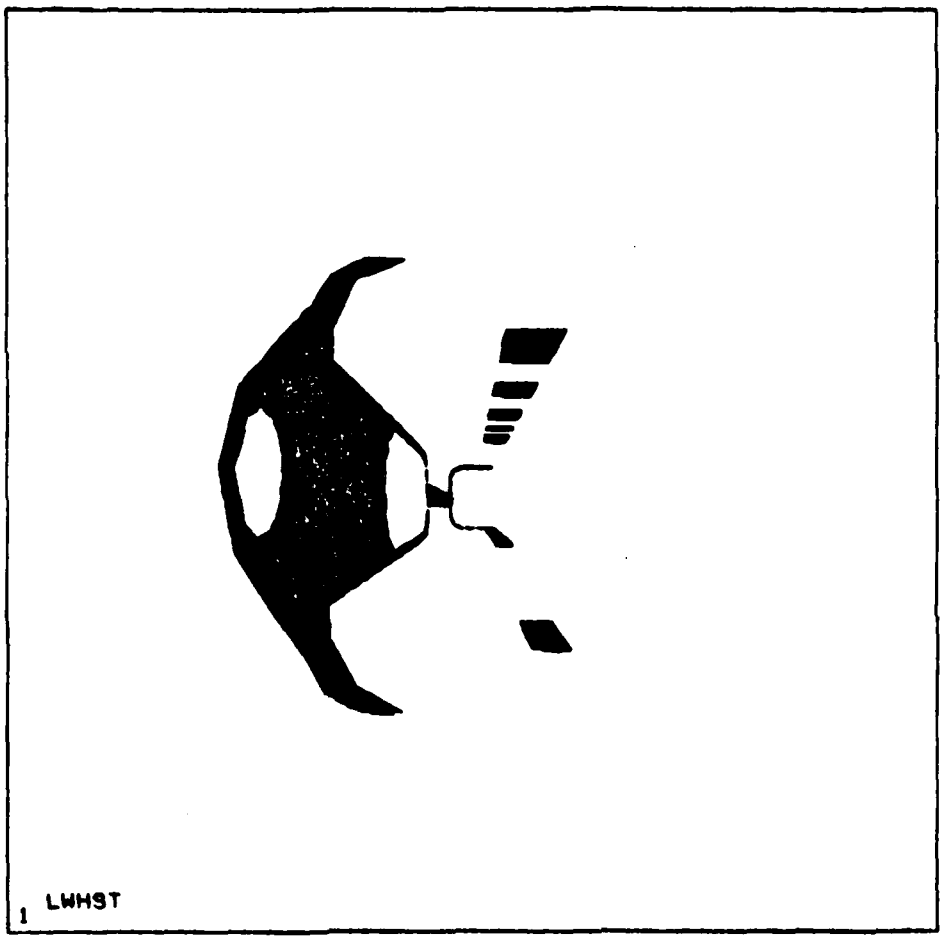
5338
6756



ANSYS 4.2B
FEB 14 1987
14:02:46
PLOT NO. 17
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=6593
MN=-18544
-15751
-12958
-10165
-7372
-4579

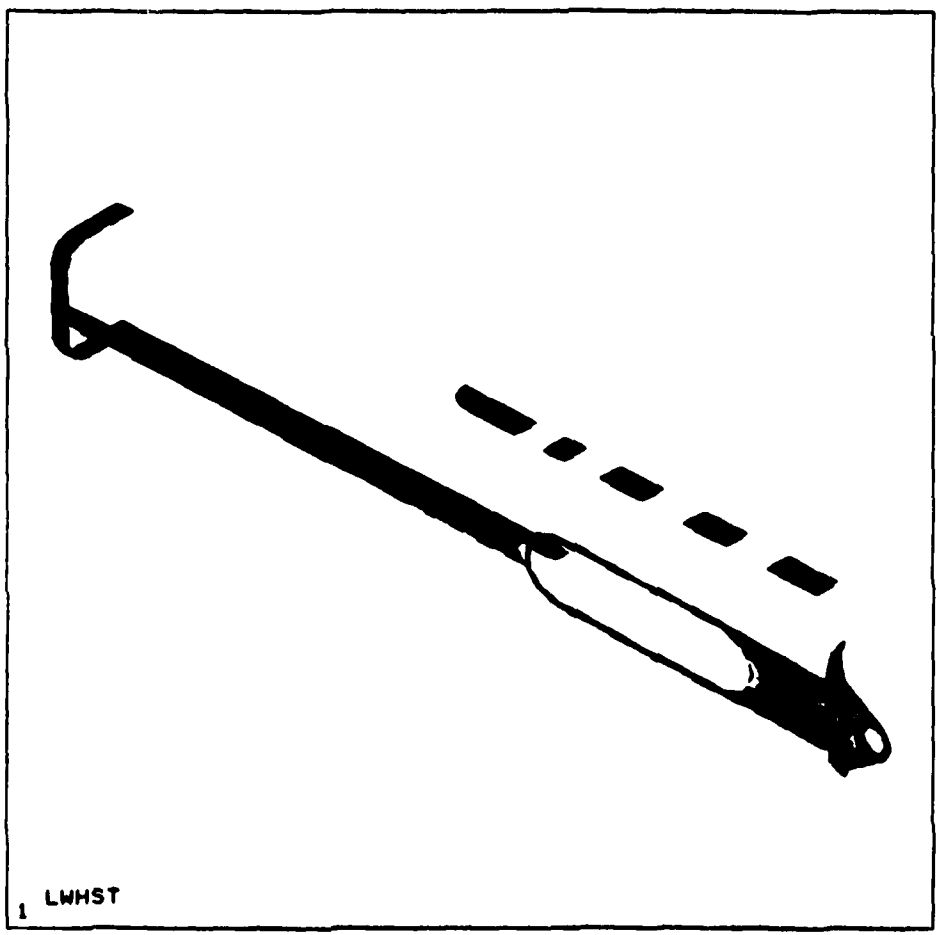
3800
6593



ANSYS 4.2B
FEB 14 1987
14:03:04
PLOT NO. 18
POST1 STRESS
STEP=1
ITER=1
SXY
TOP
STRESS ELEM CS

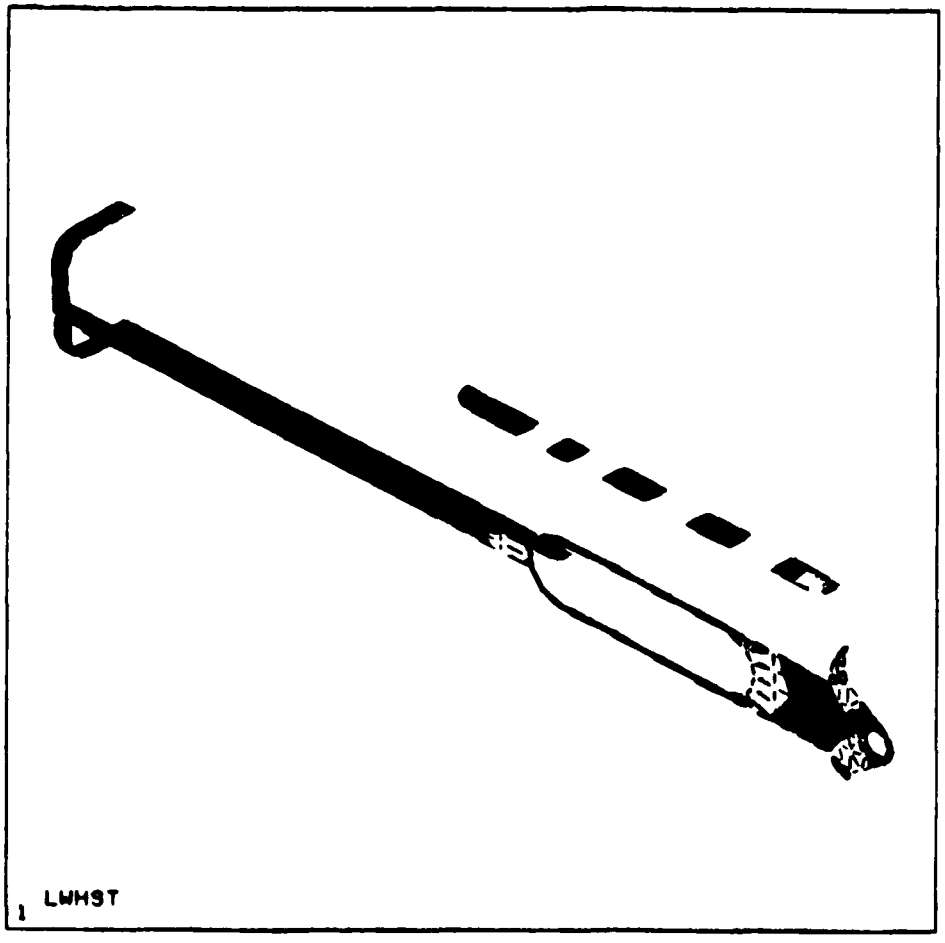
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=11738
MN=-13946
-11093
-8239
-5385
-2531
323

8885
11739



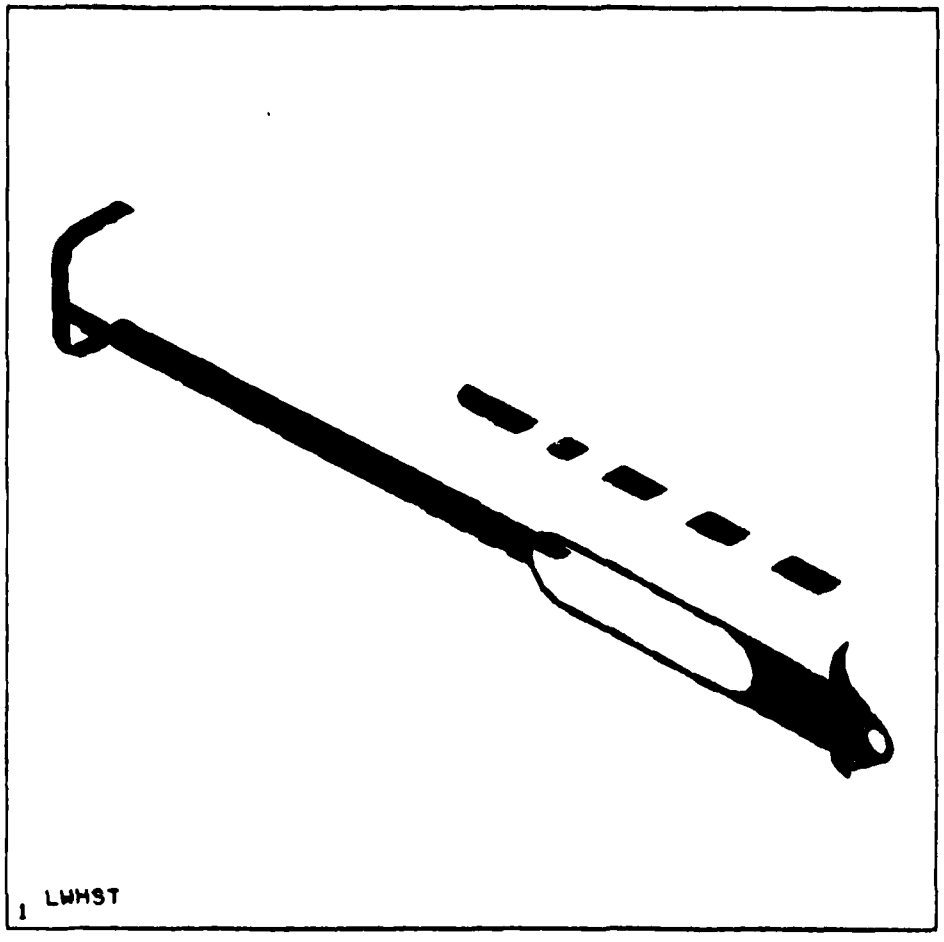
ANSYS 4.2B
FEB 14 1987
14:03:38
PLOT NO. 19
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=8196
MN=-5630
-4097
-2560
-1023
514
2051



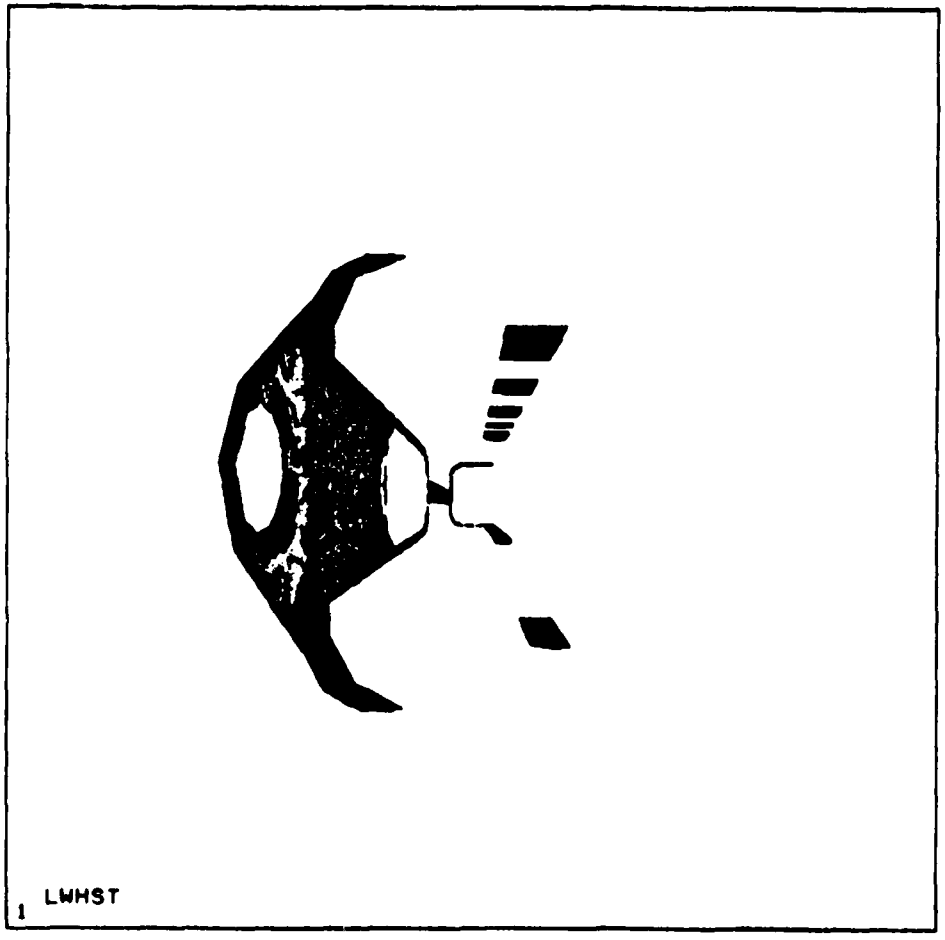
ANSYS 4.2B
FEB 14 1987
14:03:57
PLOT NO. 20
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=6154
MN=-17203
-14611
-12015
-9419
-6823
-4227



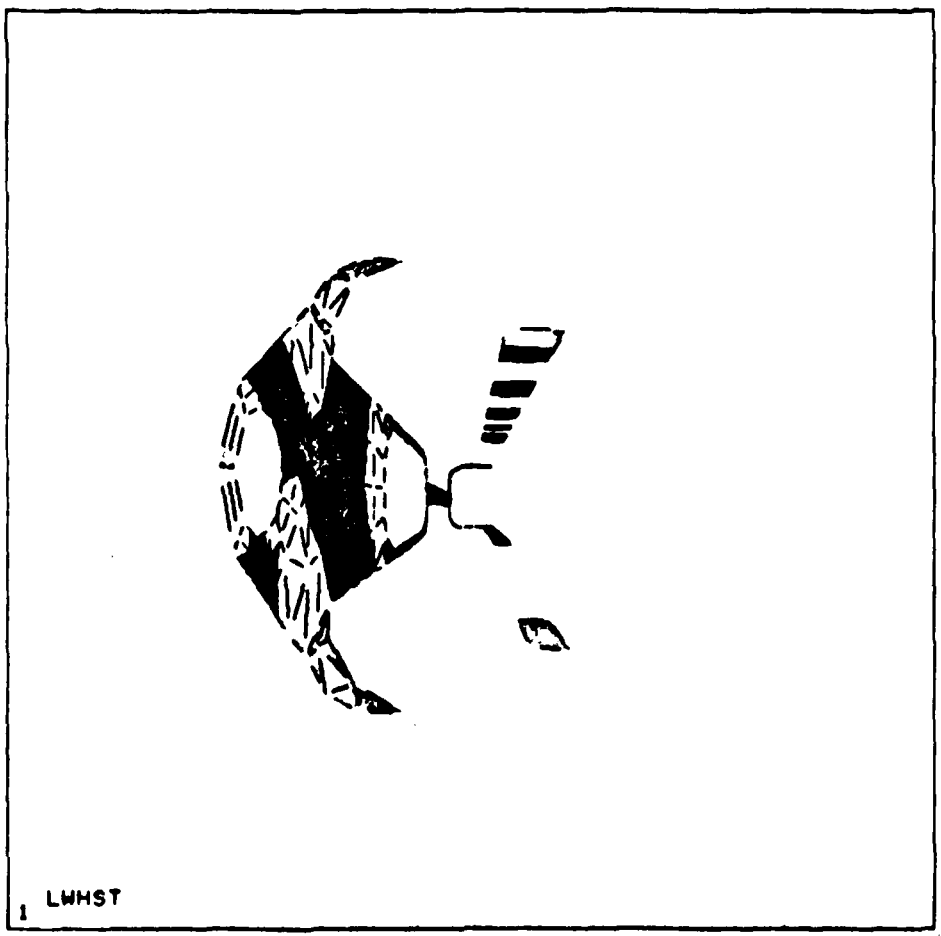
ANSYS 4.2B
FEB 14 1987
14:04:14
PLOT NO. 21
POST1 STRESS
STEP=1
ITER=1
SXY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=11982
MN=-15332
-12297
-9262
-6227
-3192
-157



ANSYS 4.2B
FEB 14 1987
14:04:33
PLOT NO. 22
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

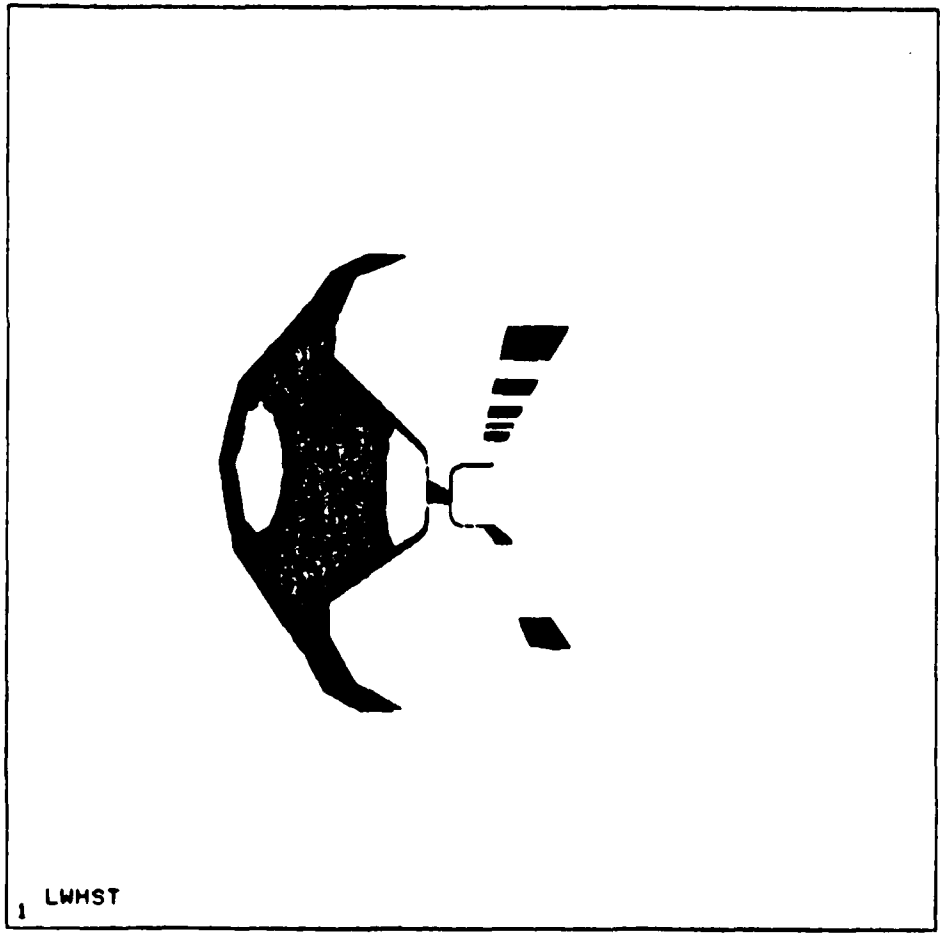
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=8196
MN=-5630
-4097
-2560
-1023
514
2051
...
...
6662
8199



ANSYS 4.2B
FEB 14 1987
14:04:50
PLOT NO. 23
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=6154
MN=-17203
-14611
-12015
-9419
-6823
-4227

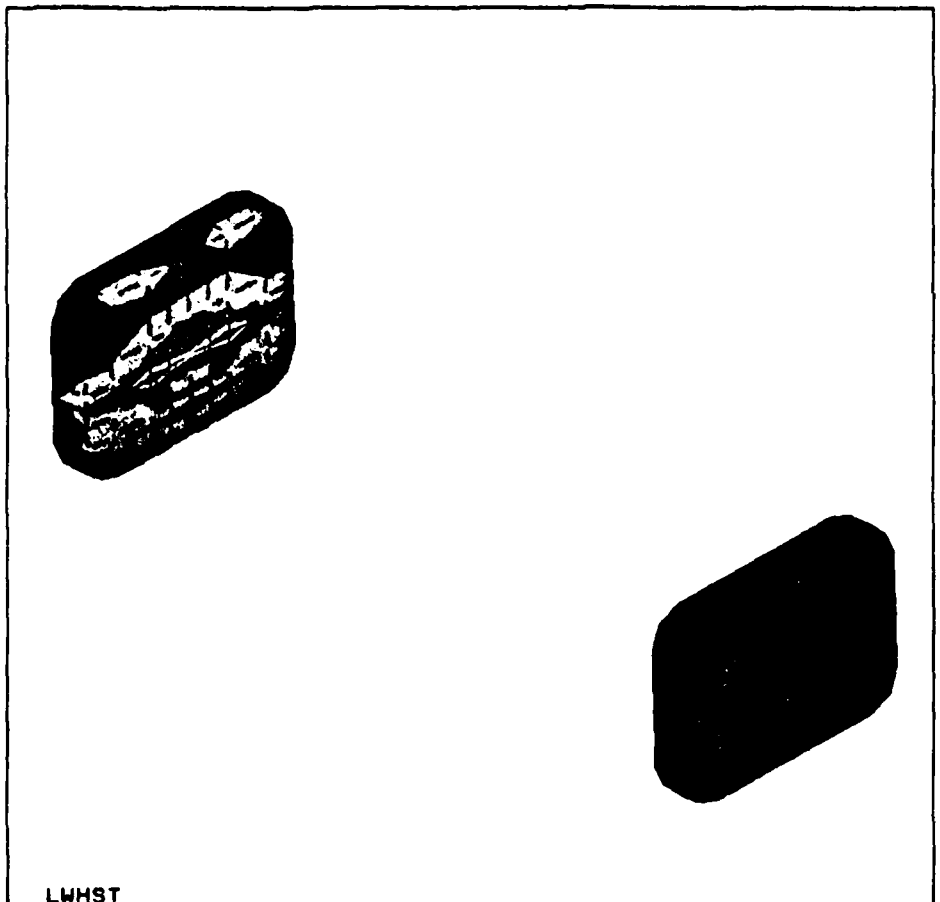
3561
6157



ANSYS 4.2B
FEB 14 1987
14:05:07
PLOT NO. 24
POST1 STRESS
STEP=1
ITER=1
SXY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=11982
MN=-15332
-12297
-9262
-6227
-3192
-157

8948
11983

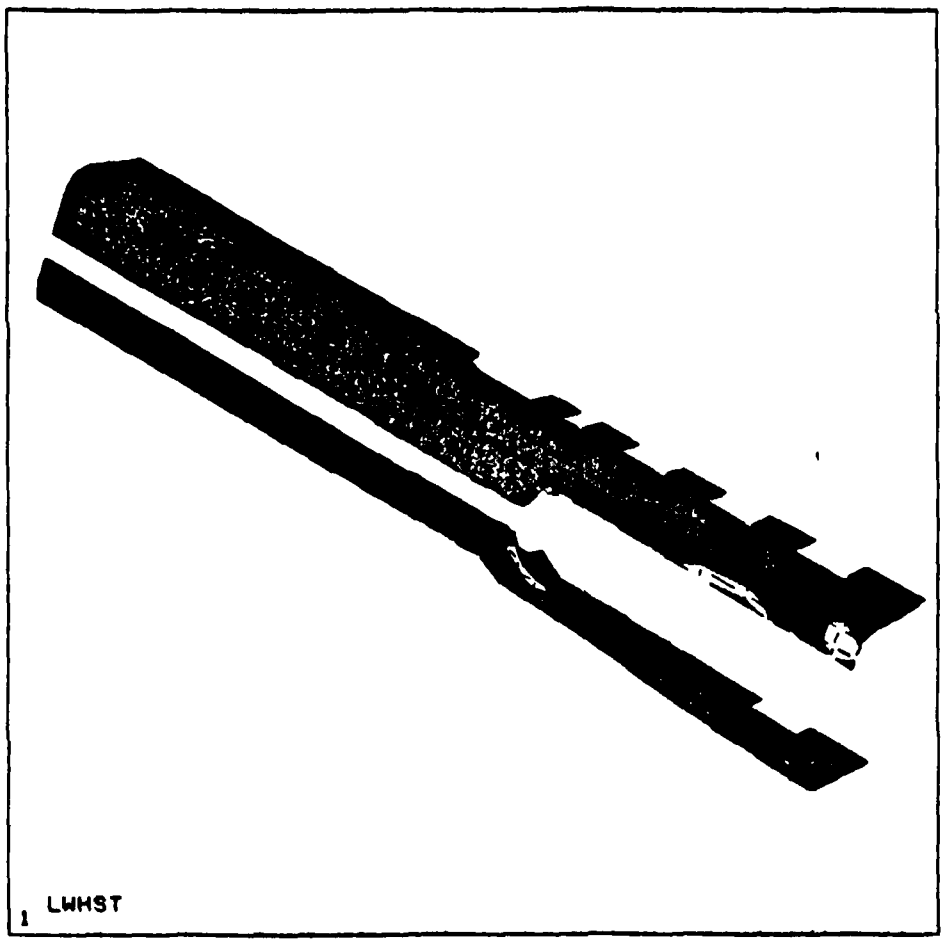


ANSYS 4.2B
FEB 14 1987
14:05:55
PLOT NO. 25
POST1 STRESS
STEP=1
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2422
MN=6.11
273
542
811
1080
1349
. . .
2156
2425

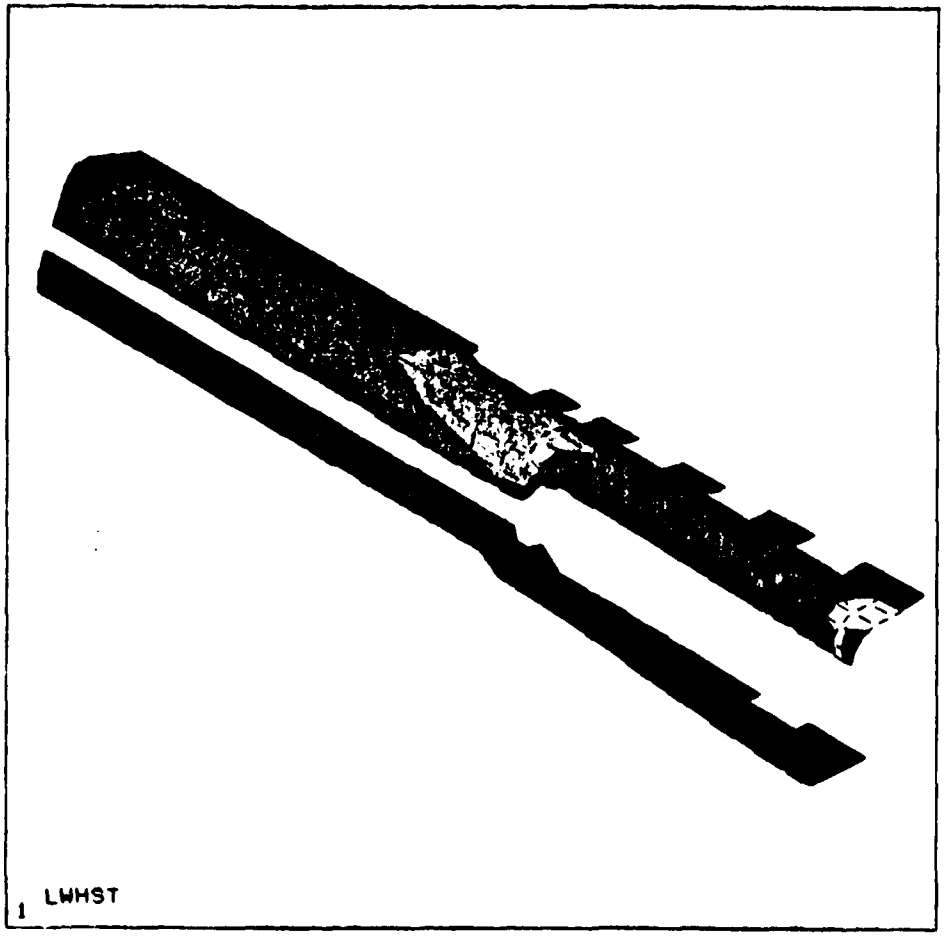
1.2

Model (12)



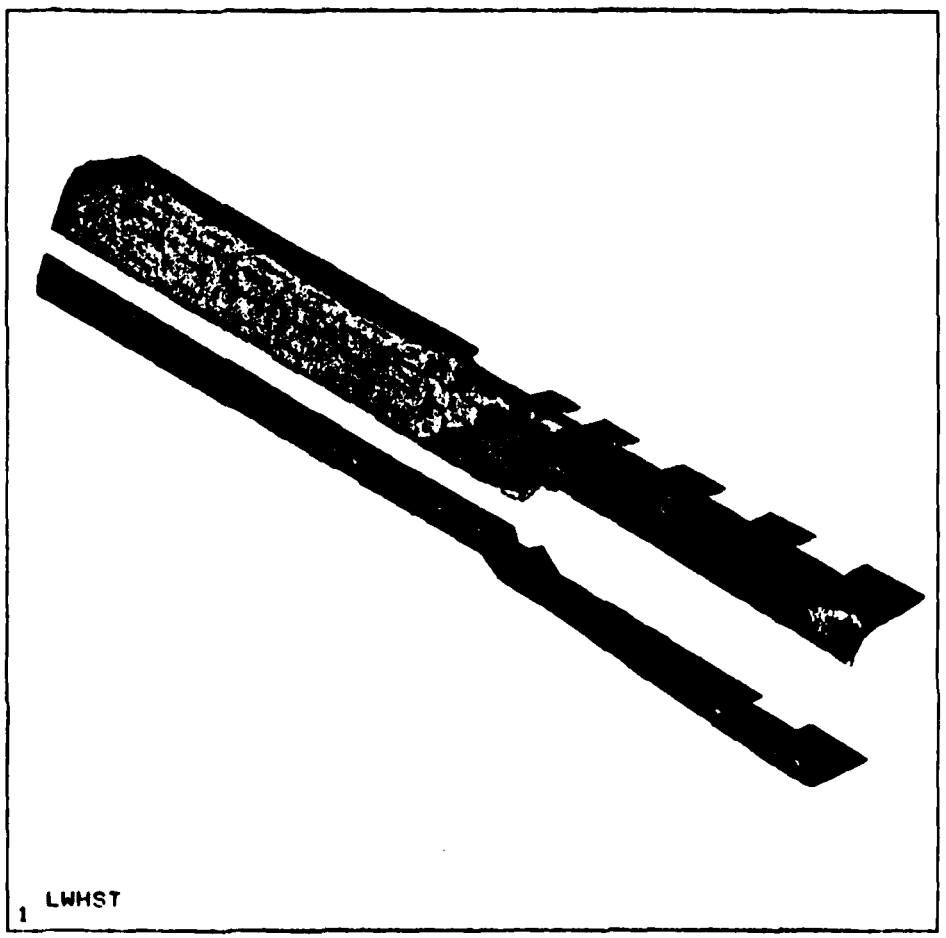
ANSYS 4.2B
FEB 14 1987
14:09:00
PLOT NO. 26
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=11508
MN=-11549
-8988
-6426
-3864
-1302
1260



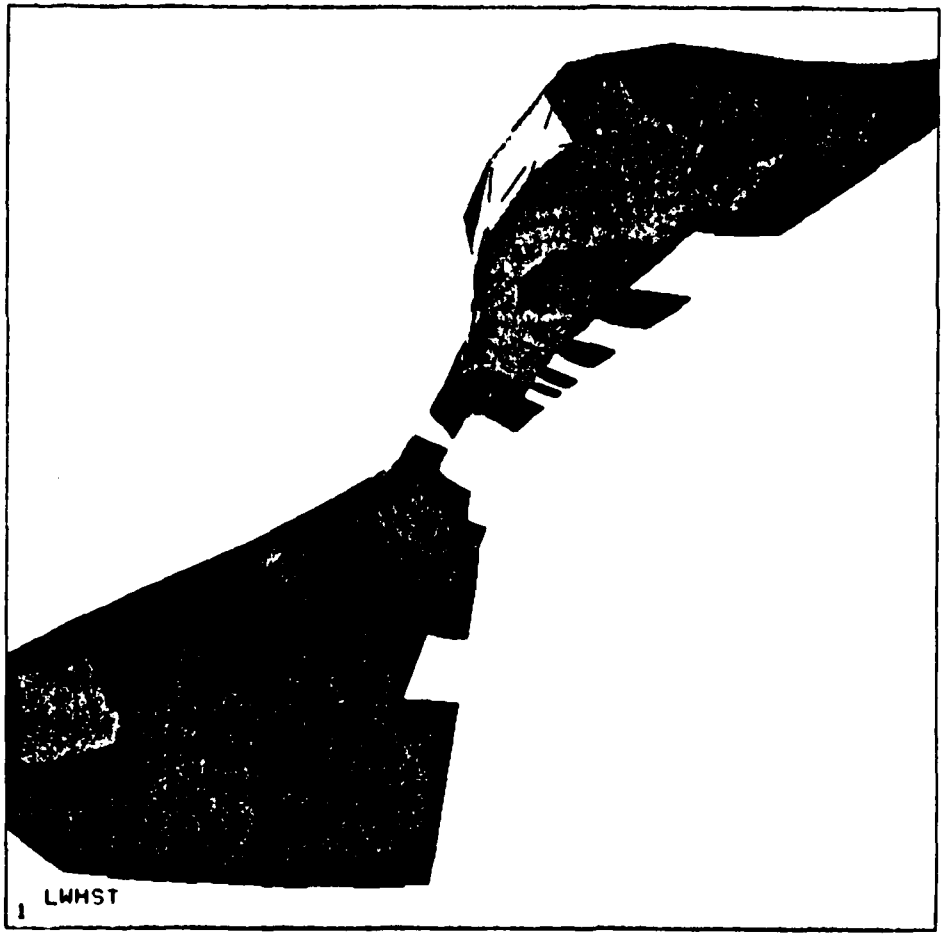
ANSYS 4.2B
FEB 14 1987
14:09:34
PLOT NO. 27
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=18920
MN=-19948
-15630
-11311
-6992
-2673
1646



ANSYS 4.2B
FEB 14 1987
14:10:05
PLOT NO. 28
POST1 STRESS
STEP=2
ITER=1
SXY
TOP
STRESS ELEM CS

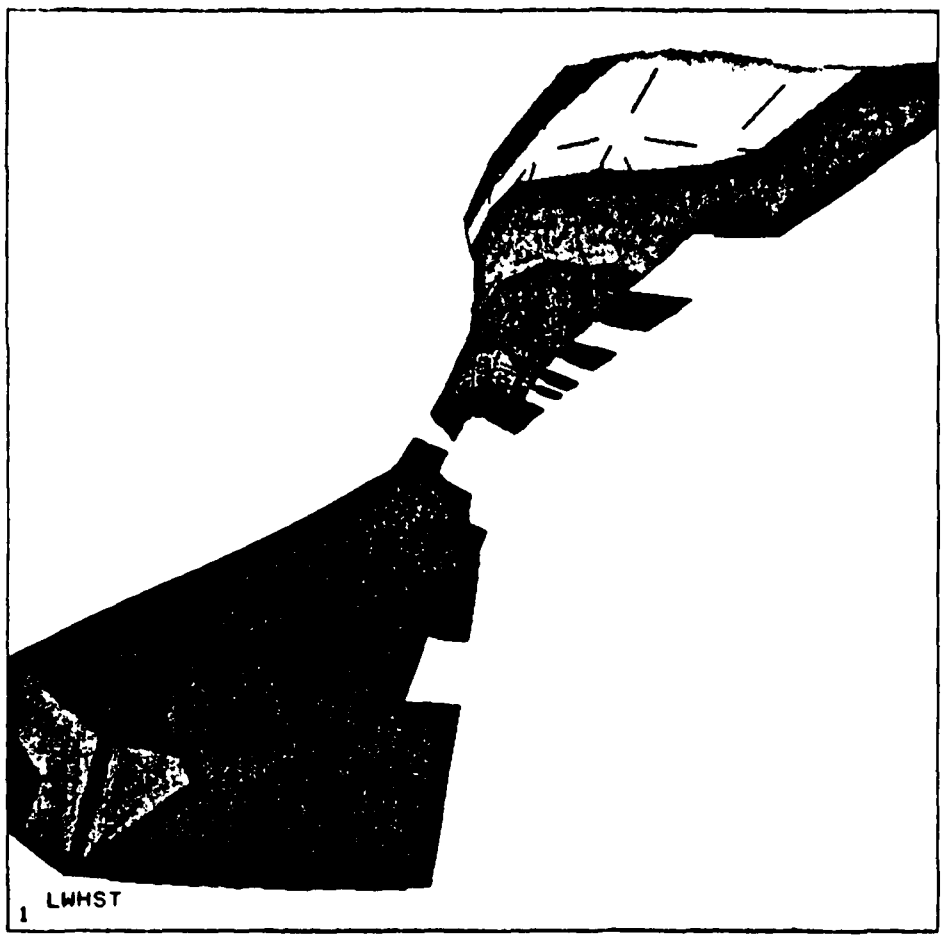
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=12516
MN=-2425
-768
893
2554
4215
5876



ANSYS 4.2B
FEB 14 1987
14:10:37
PLOT NO. 29
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=11508
MN=-11549
-8988
-6426
-3864
-1302
1260

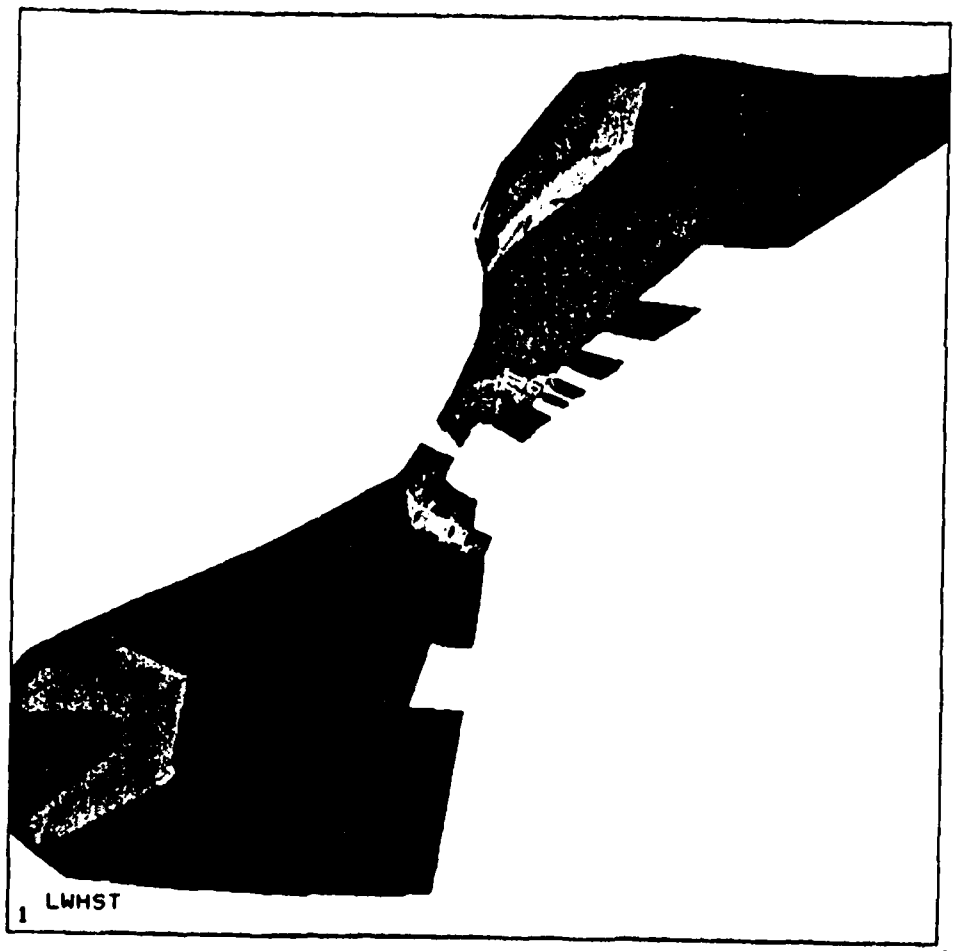
8946
11508



ANSYS 4.2B
FEB 14 1987
14:11:08
PLOT NO. 30
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=18920
MN=-19948
-15630
-11311
-6992
-2673
1646

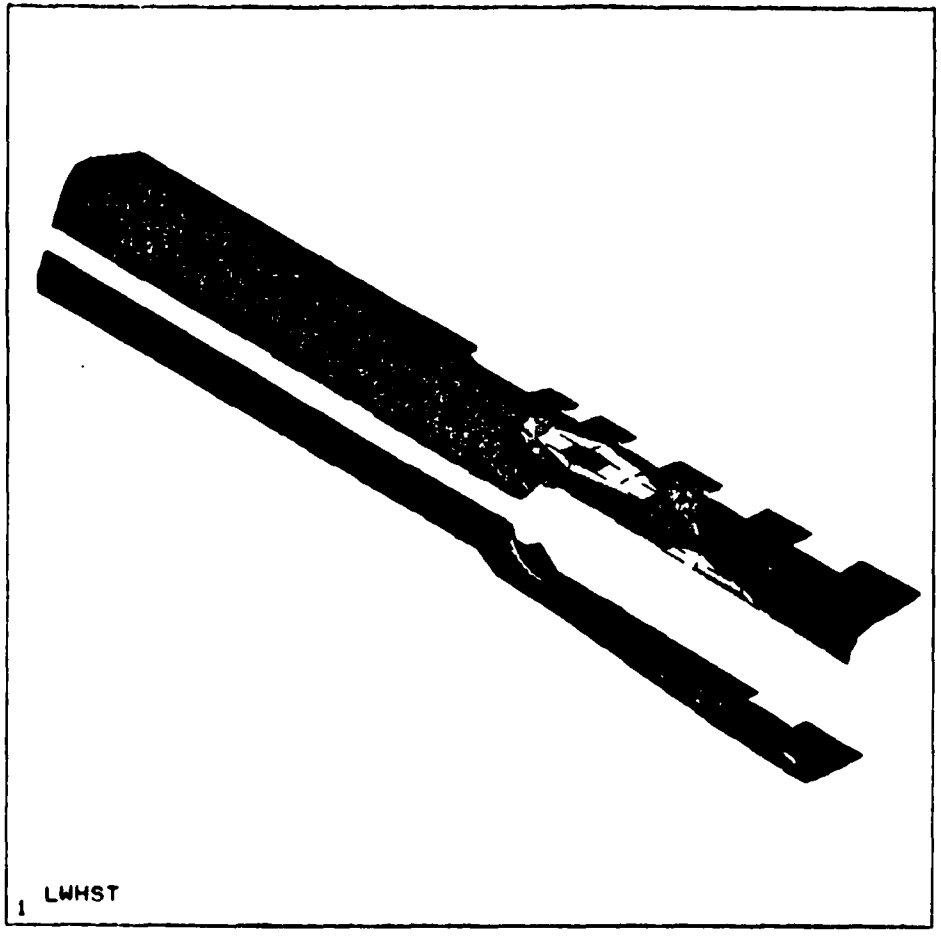
14603
18922



ANSYS 4.2B
FEB 14 1987
14:11:40
PLOT NO. 31
POST1 STRESS
STEP=2
ITER=1
SXY
TOP
STRESS ELEM CS

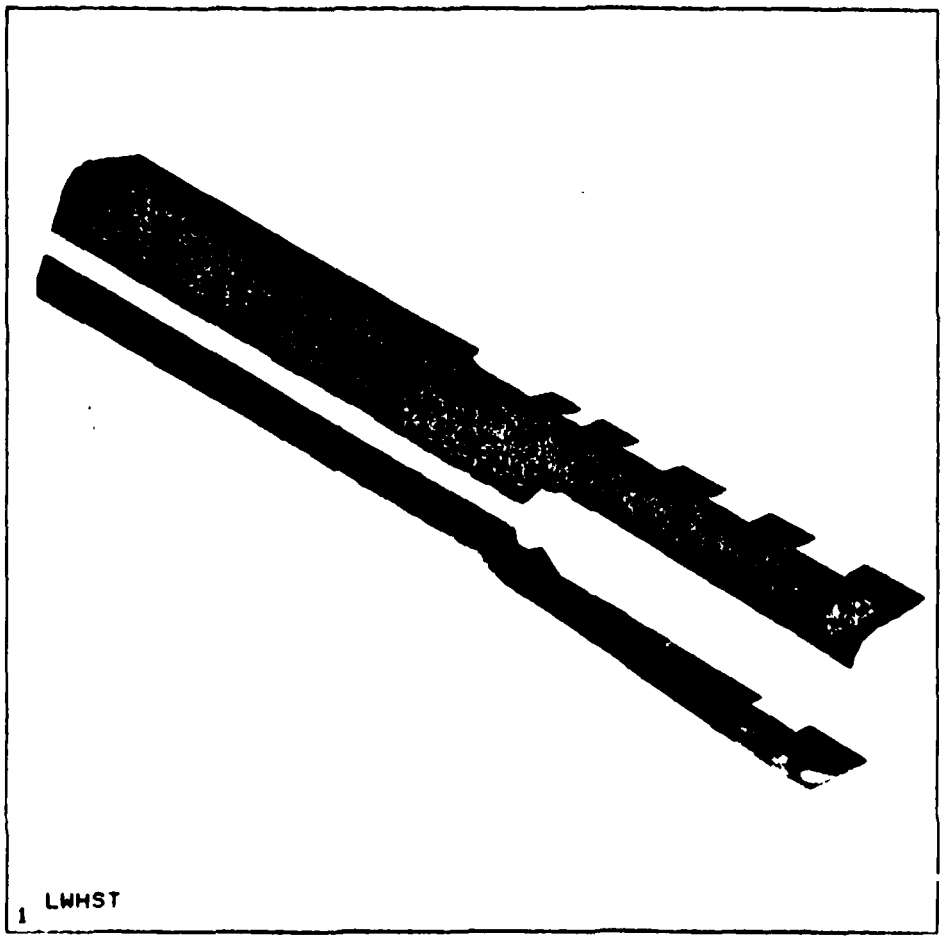
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=12516
MN=-2425
-768
893
2554
4215
5876

10859
12520



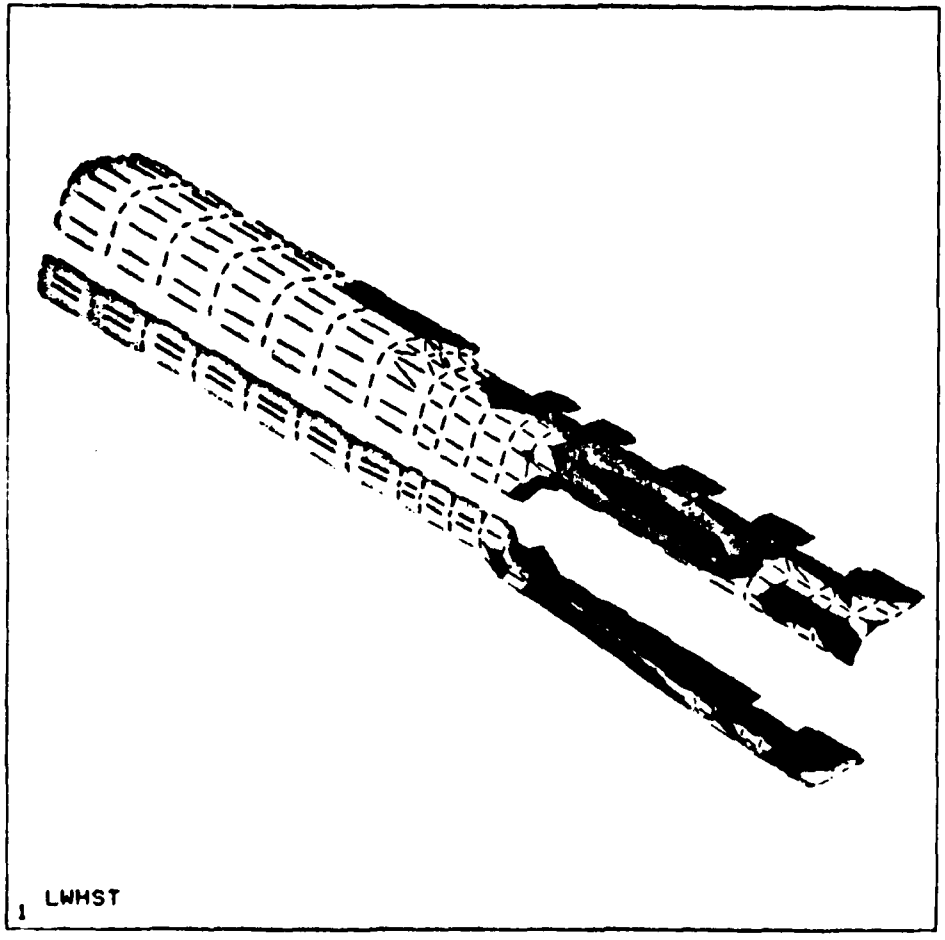
ANSYS 4.2B
FEB 14 1987
14:13:02
PLOT NO. 32
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=8742
MN=-8432
-6527
-4618
-2709
-800
1109



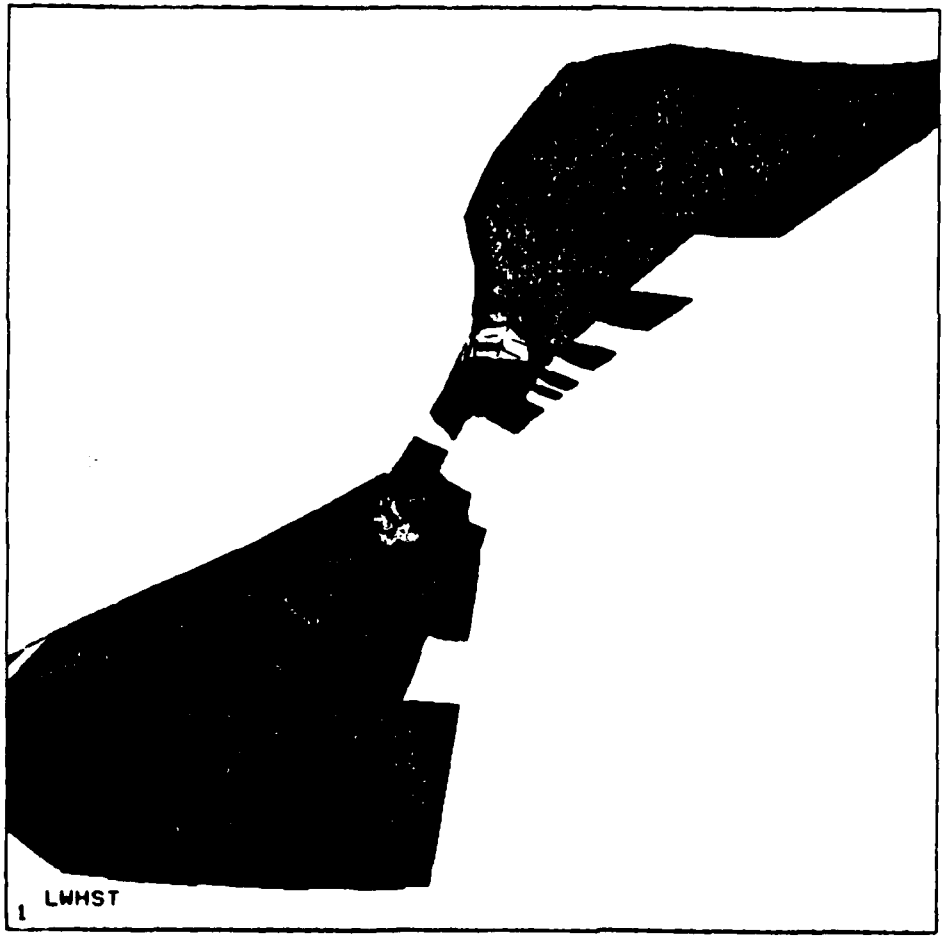
ANSYS 4.2B
FEB 14 1987
14:14:41
PLOT NO. 33
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=12296
MN=-12308
-9575
-6841
-4107
-1373
1361



ANSYS 4.2B
FEB 14 1987
14:15:14
PLOT NO. 34
POST1 STRESS
STEP=2
ITER=1
SXY
BOTTOM
STRESS ELEM CS

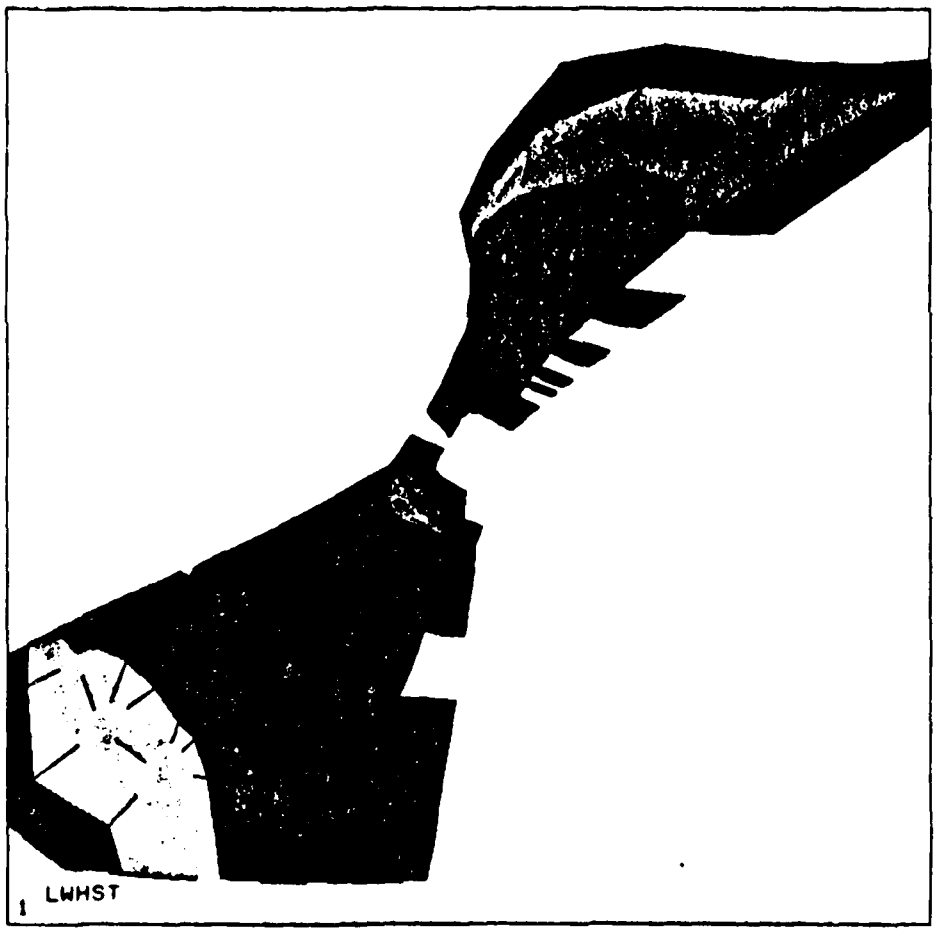
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=4882
MN=-10648
-8924
-7198
-5472
-3746
-2020



ANSYS 4.2B
FEB 14 1987
14:15:46
PLOT NO. 35
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=8742
MN=-8432
-6527
-4618
-2709
-800
1109

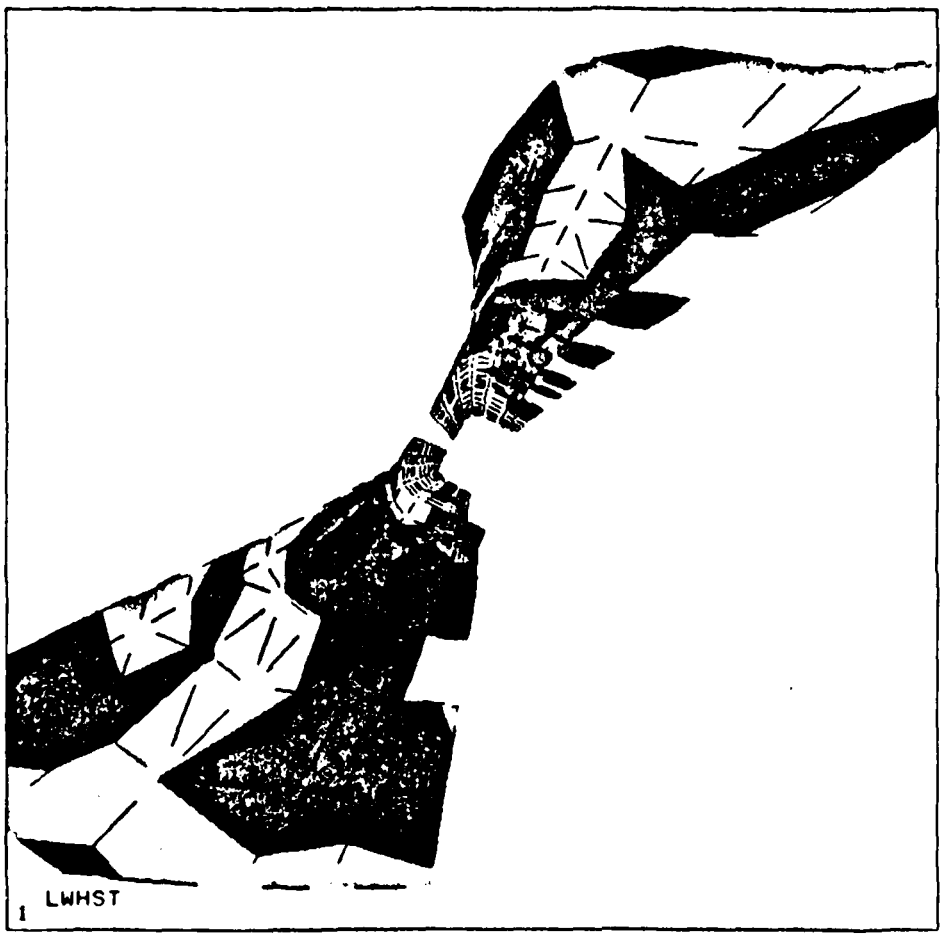
6836
8745



ANSYS 4.2B
FEB 14 1987
14:16:17
PLOT NO. 36
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=12296
MN=-12308
-9575
-6841
-4107
-1373
1361

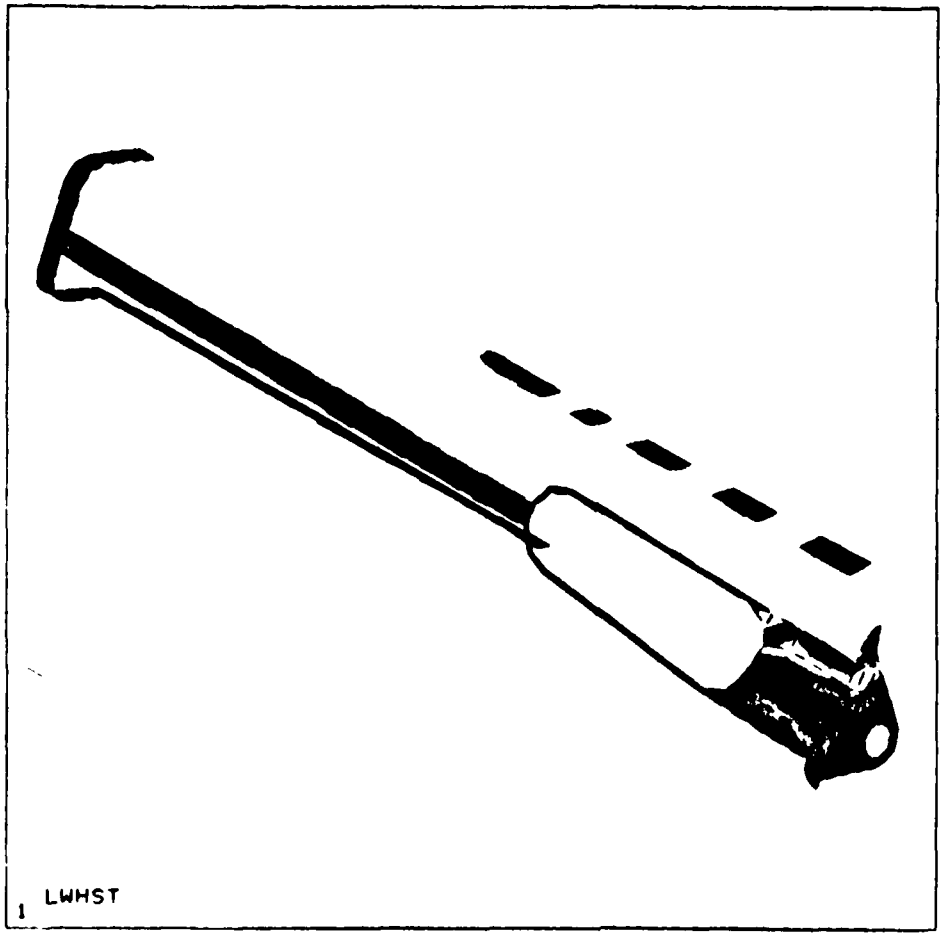
9563
12297



ANSYS 4.2B
FEB 14 1987
14:16:51
PLOT NO. 37
POST1 STRESS
STEP=2
ITER=1
SXY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=4882
MN=-10648
-8924
-7198
-5472
-3746
-2020

3158
4884

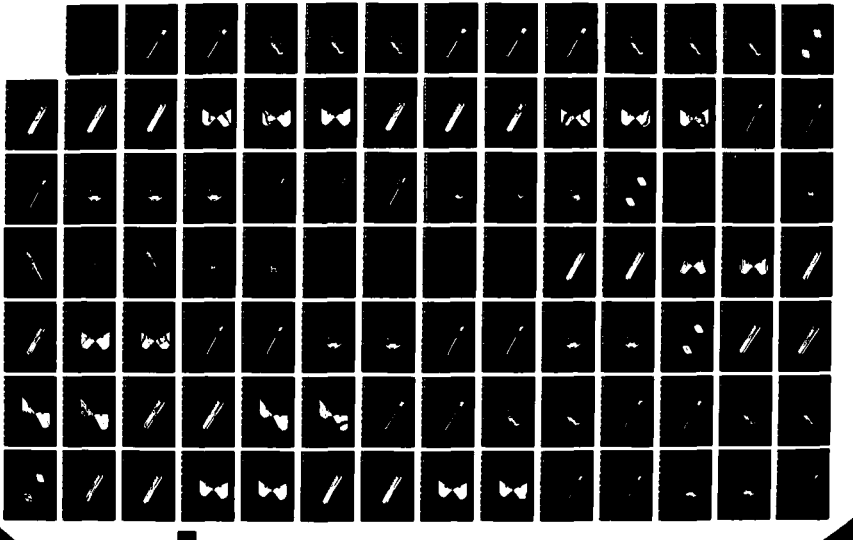


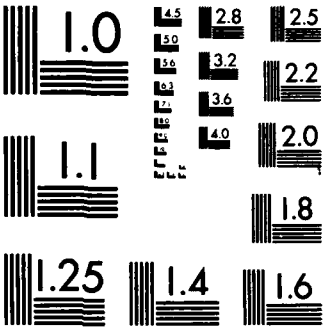
ANSYS 4.2B
FEB 14 1987
14:17:56
PLOT NO. 38
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=24413
MN=-25097
-19599
-14097
-8595
-3093
2409

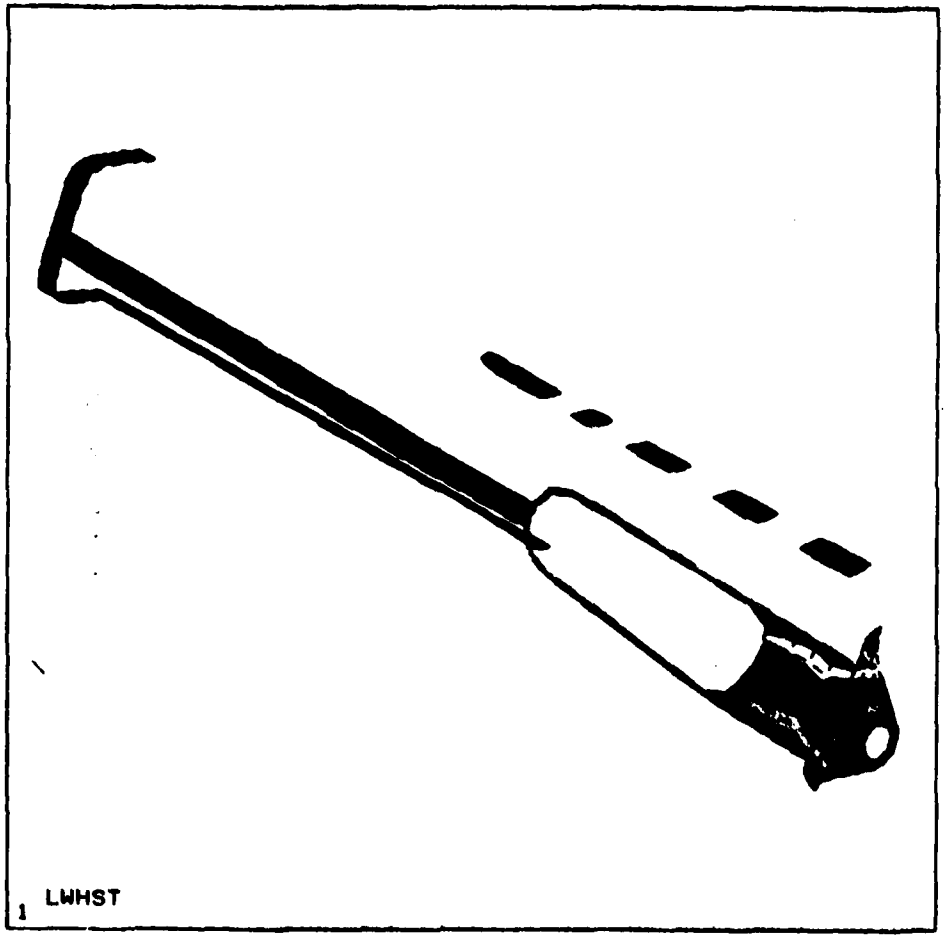
AD-A183 991 LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN NORTHERN ORDNANCE DIV R RATHE ET AL APR 87 3/5

UNCLASSIFIED FMC-E-3041-VOL-D2-PT-3 DAAA21-86-C-0047 F/G 19/6 NL



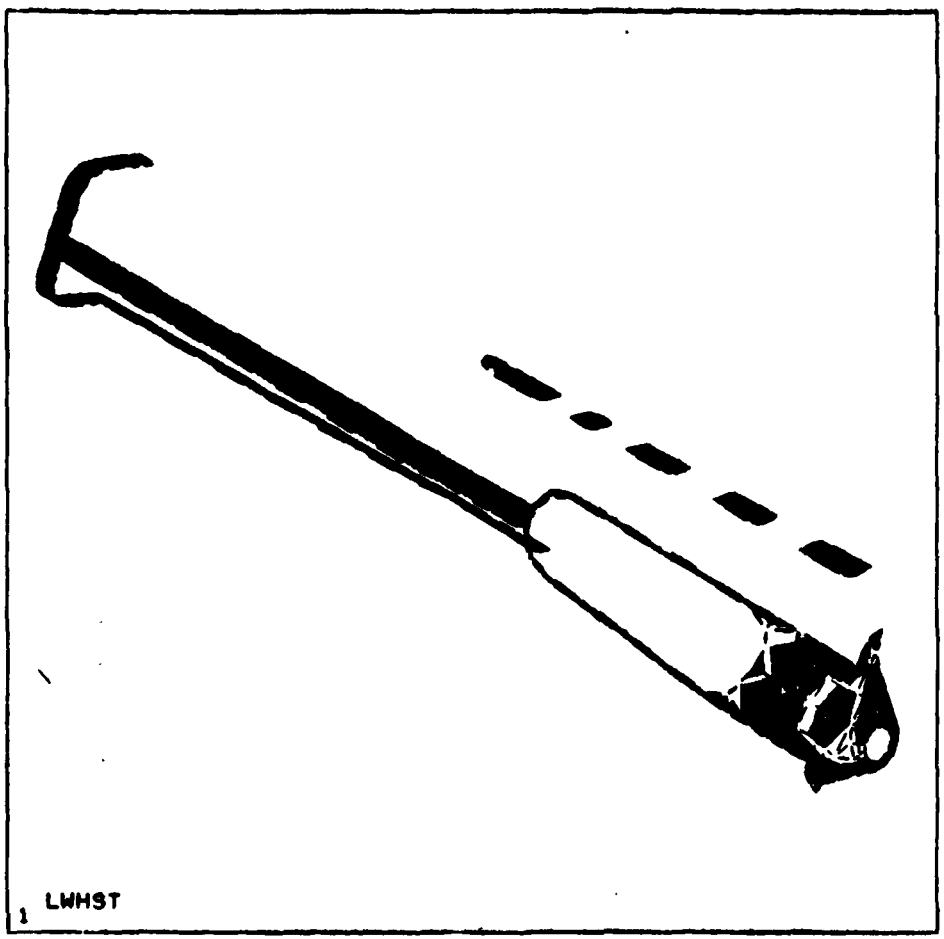


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



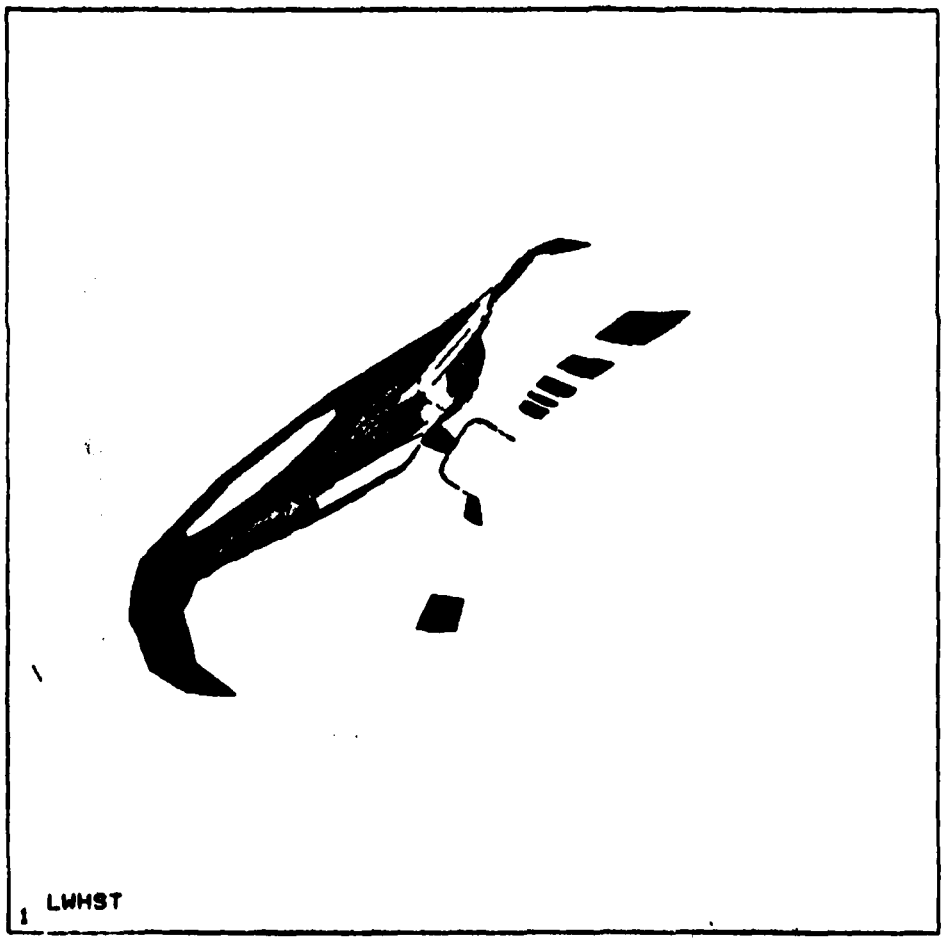
ANSYS 4.2B
FEB 14 1987
14:18:17
PLOT NO. 38
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=12586
MN=-12074
-9334
-6594
-3854
-1114
1626



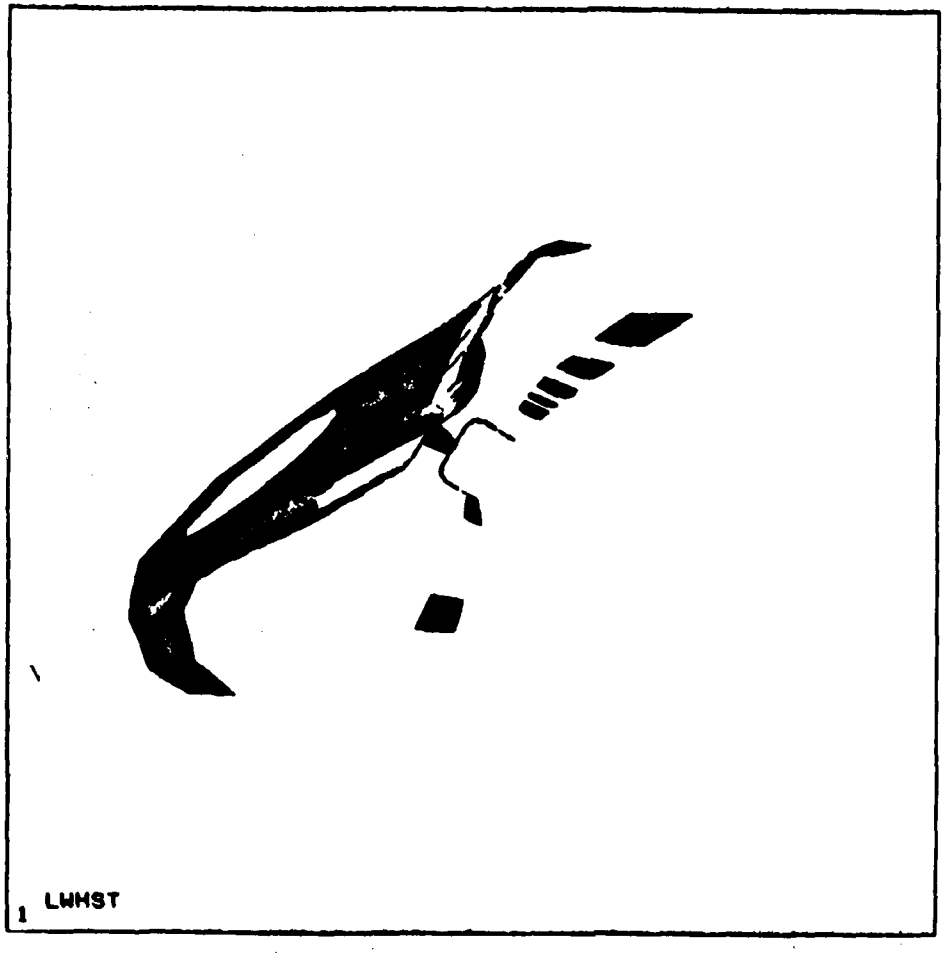
ANSYS 4.2B
FEB 14 1987
14:18:34
PLOT NO. 40
POST1 STRESS
STEP=2
ITER=1
SXY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=5156
MN=-9077
-7497
-5915
-4333
-2751
-1169



ANSYS 4.2B
FEB 14 1987
14:18:55
PLOT NO. 41
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

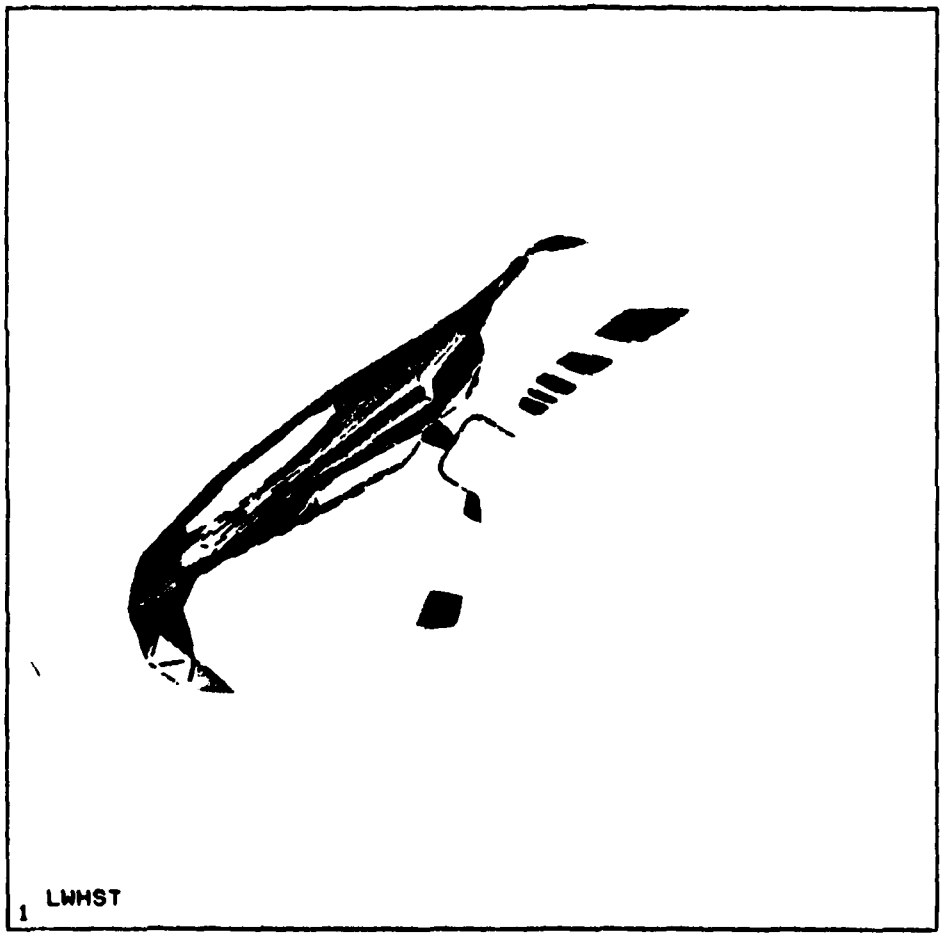
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=24413
MN=-25097
-19599
-14097
-8595
-3093
2409
7911
13413
18915
24417



ANSYS 4.2B
FEB 14 1987
14:19:12
PLOT NO. 42
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

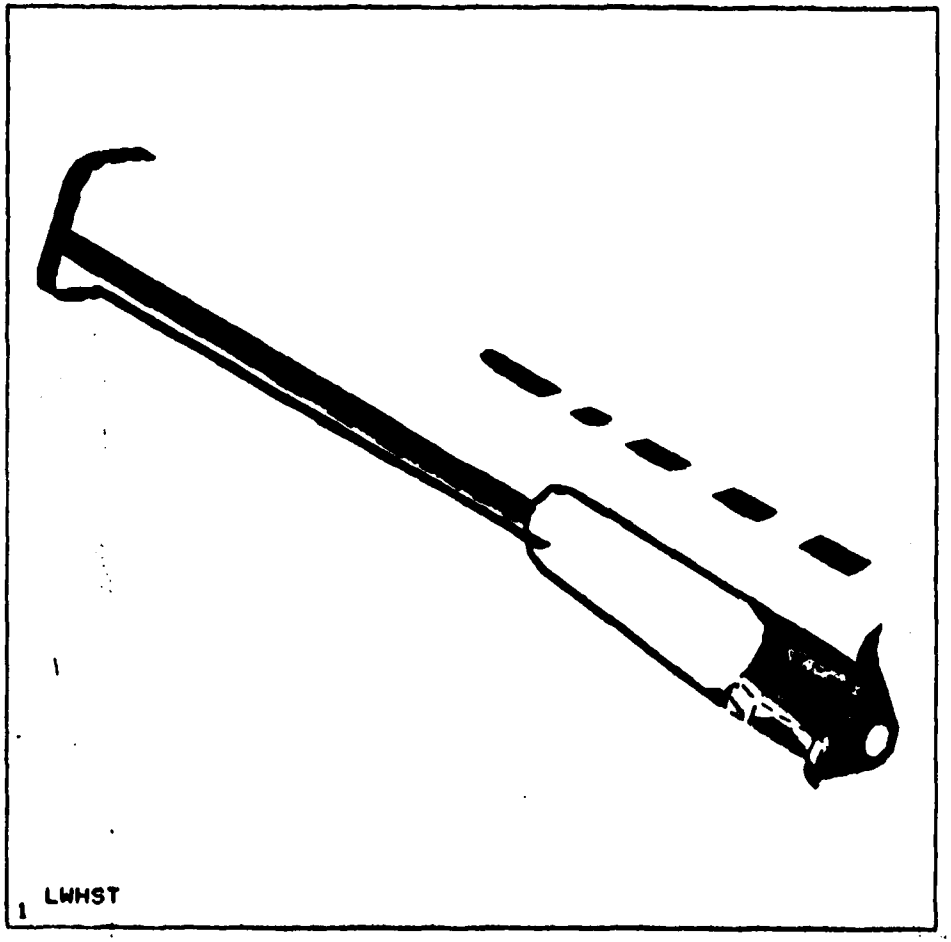
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=12586
MN=-12074
-9334
-6594
-3854
-1114
1626
.
.
.
9846
12586

44



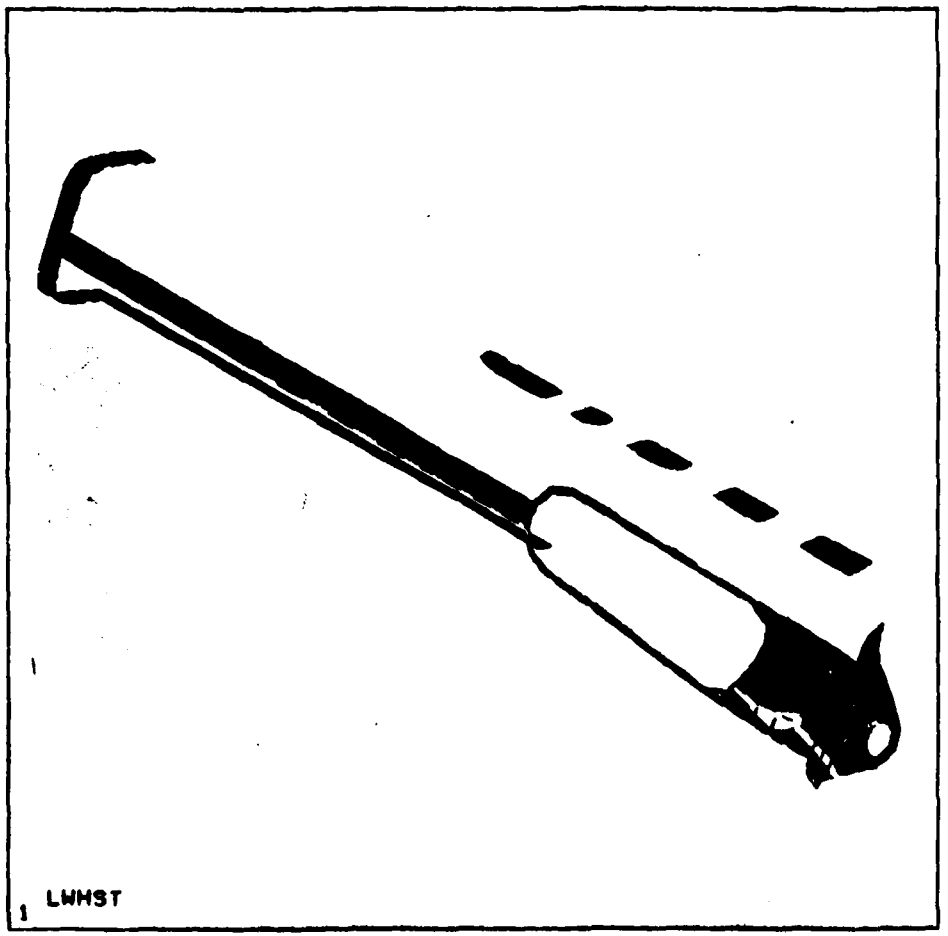
ANSYS 4.2B
FEB 14 1987
14:19:29
PLOT NO. 43
POST1 STRESS
STEP=2
ITER=1
SXY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=5156
MN=-9077
-7497
-5915
-4333
-2751
-1169
3577
5159



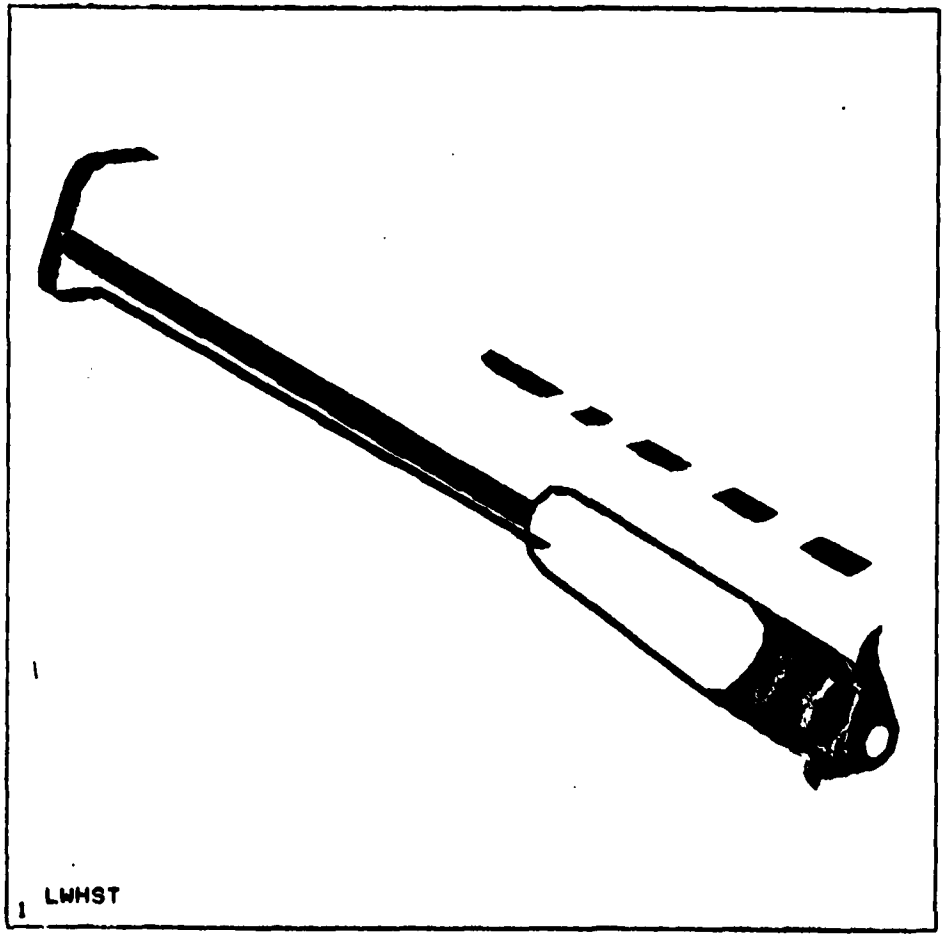
ANSYS 4.2B
FEB 14 1987
14:20:06
PLOT NO. 44
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=25061
MN=-24260
-18783
-13302
-7821
-2340
3141



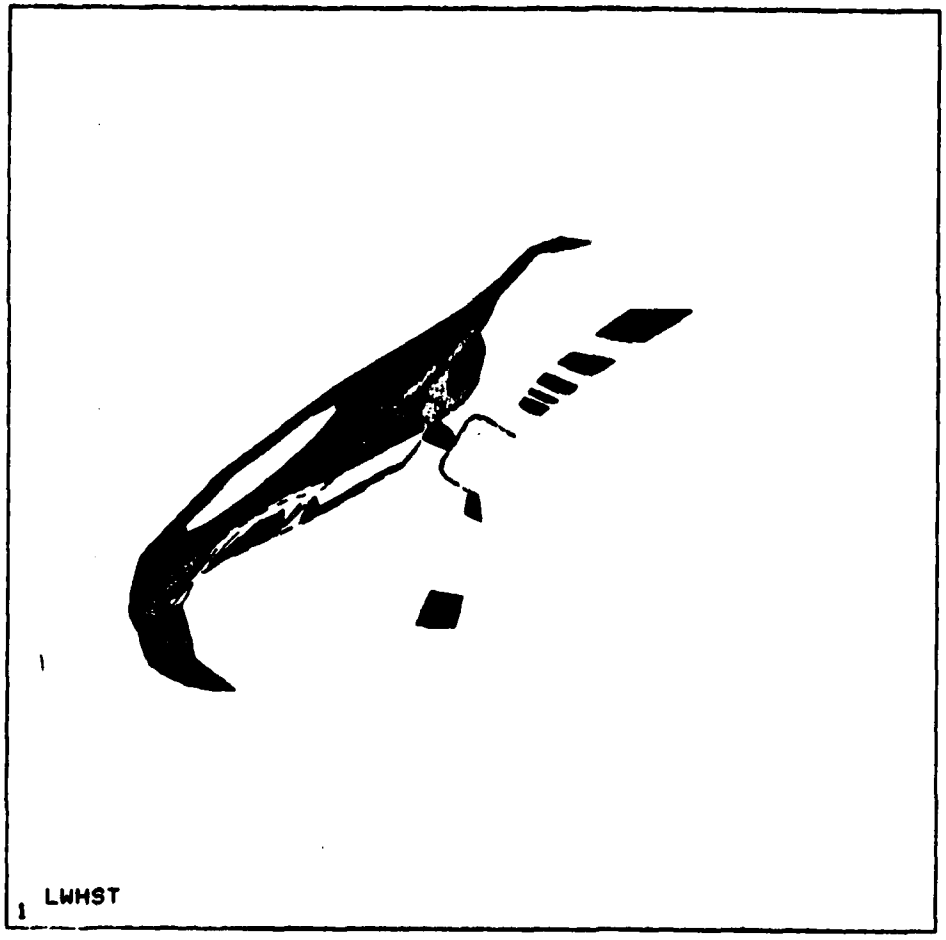
ANSYS 4.2B
FEB 14 1987
14:20:23
PLOT NO. 45
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=9397
MN=-9905
-7762
-5617
-3472
-1327
818



ANSYS 4.2B
FEB 14 1987
14:20:42
PLOT NO. 46
POST1 STRESS
STEP=2
ITER=1
SXY
BOTTOM
STRESS ELEM CS

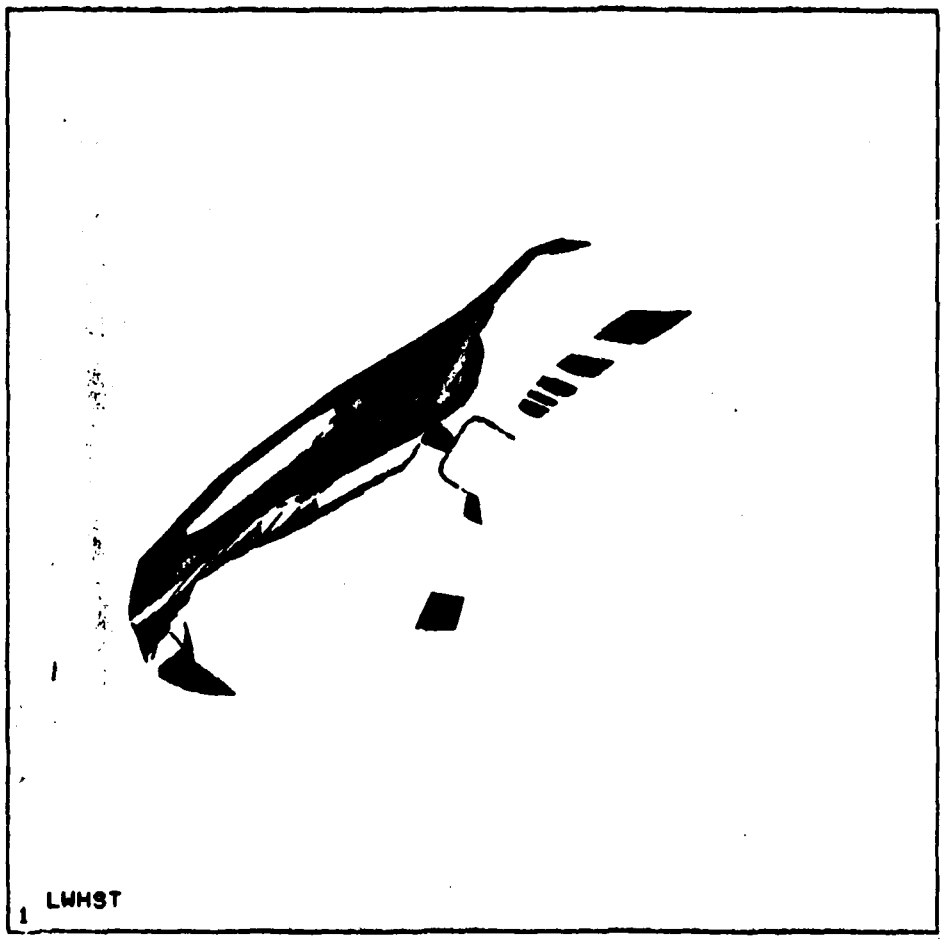
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=7645
MN=-5585
-4119
-2648
-1177
294
1765



ANSYS 4.2B
FEB 14 1987
14:21:01
PLOT NO. 47
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

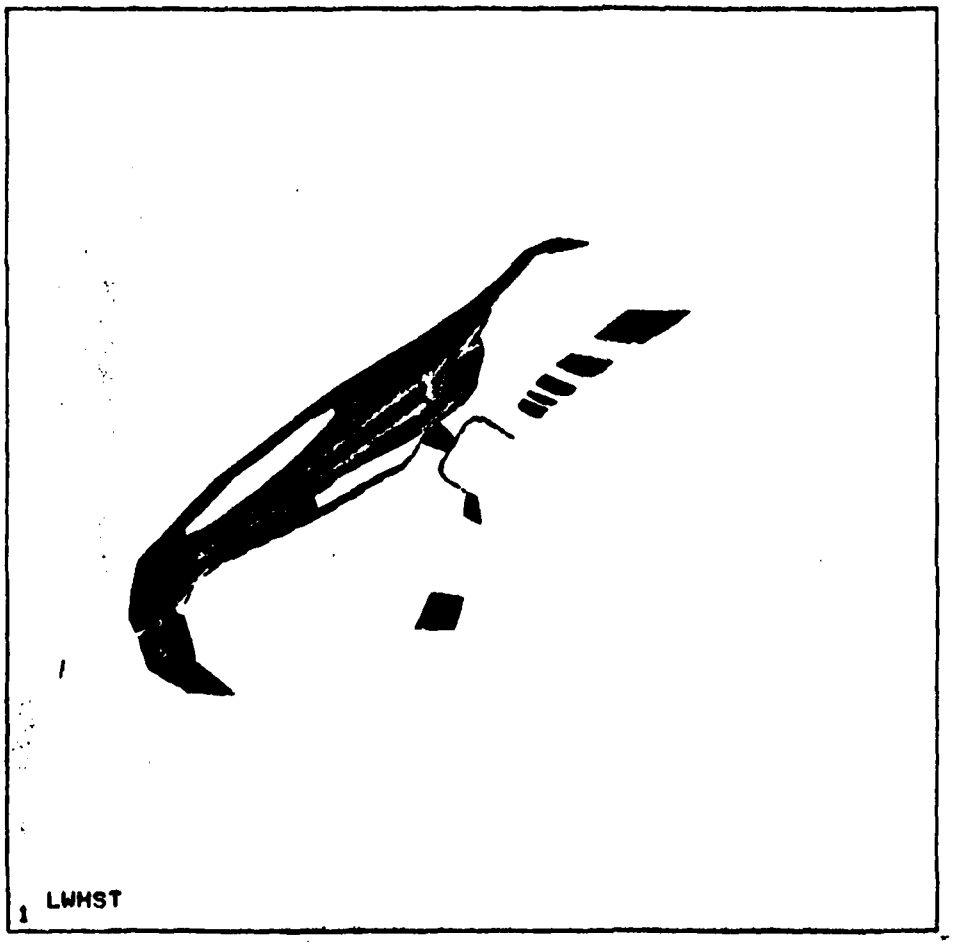
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=25061
MN=-24260
-18783
-13302
-7821
-2340
3141

19584
25065



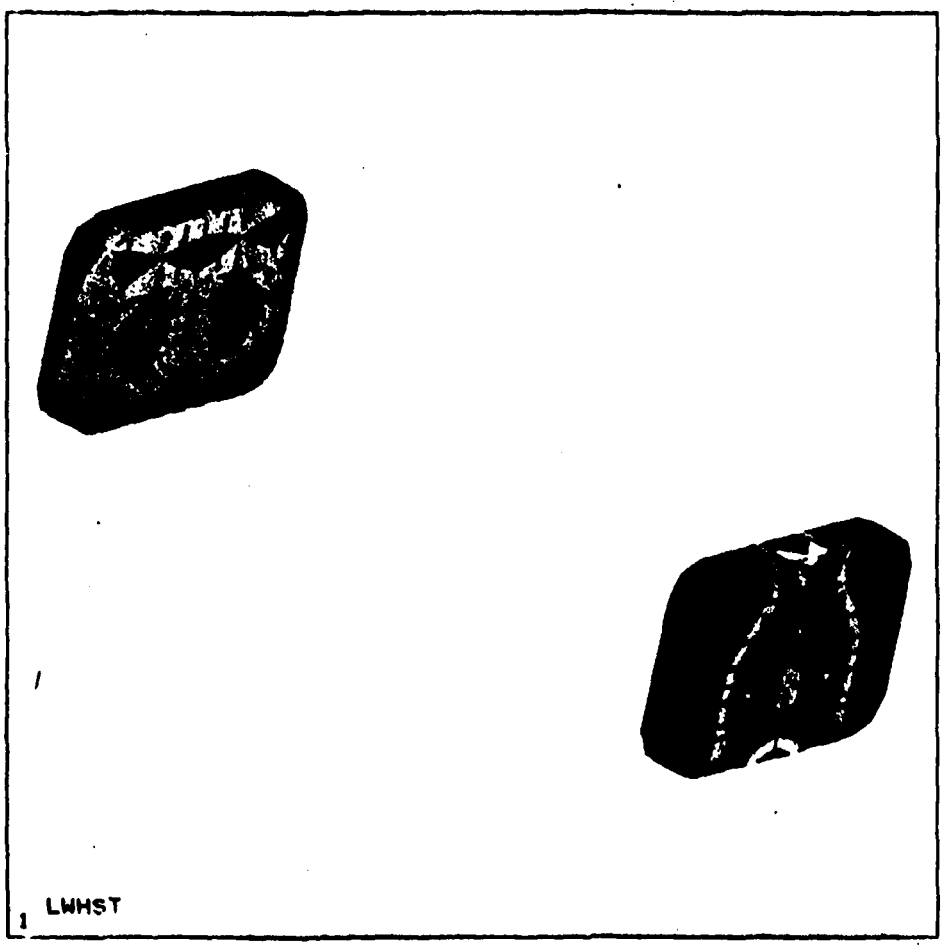
ANSYS 4.2B
FEB 14 1987
14:21:18
PLOT NO. 48
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=9397
MN=-9905
-7762
-5617
-3472
-1327
816
7253
9398



ANSYS 4.2B
FEB 14 1987
14:21:35
PLOT NO. 49
POST1 STRESS
STEP=2
ITER=1
SXY
BOTTOM
STRESS ELEM CS

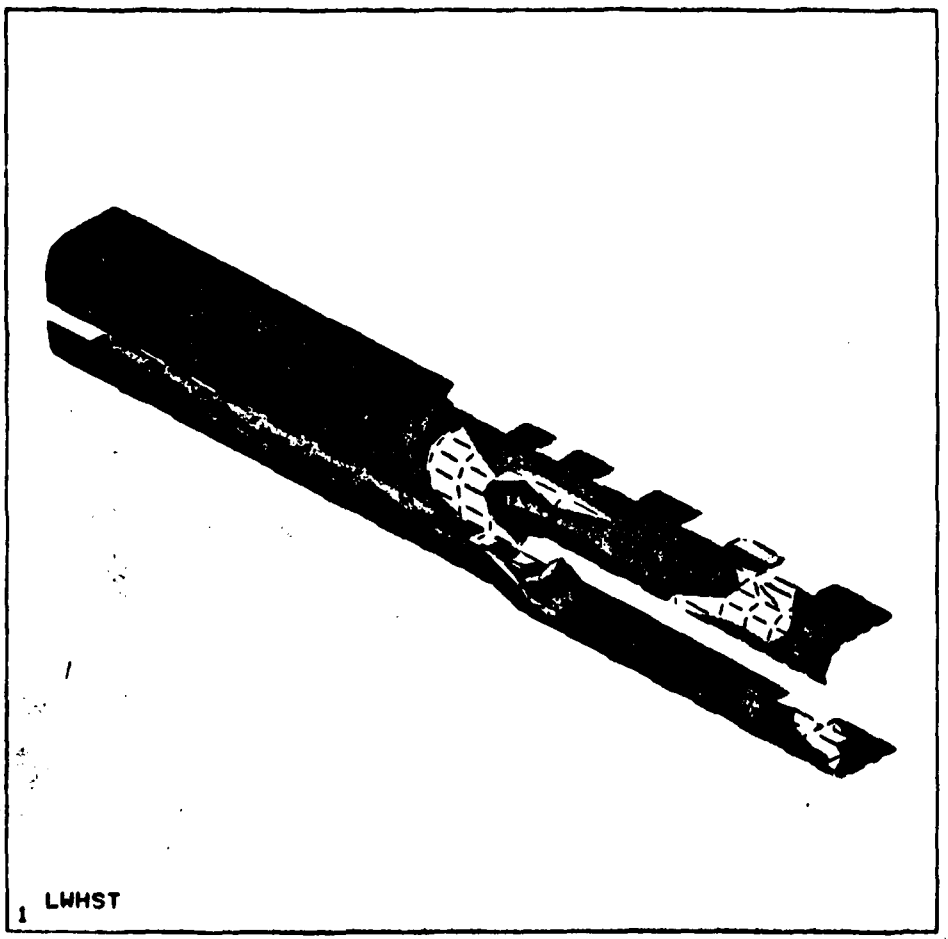
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=7645
MN=-5585
-4119
-2648
-1177
294
1765
6178
7649



ANSYS 4.2B
FEB 14 1987
14:22:23
PLOT NO. 50
POST1 STRESS
STEP=2
ITER=1
SIGE
BOTTOM

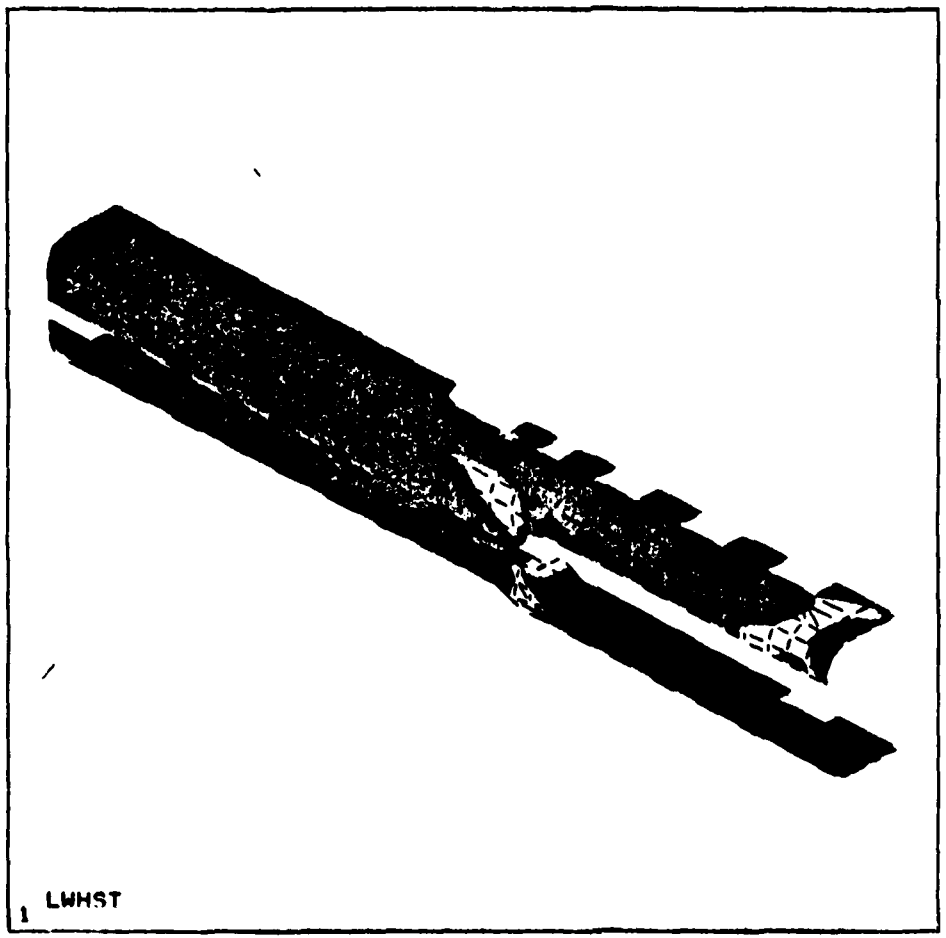
XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=257
MN=8.05
34.3
62.3
90.3
118
146
[illegible]
230
258

Modul (12).



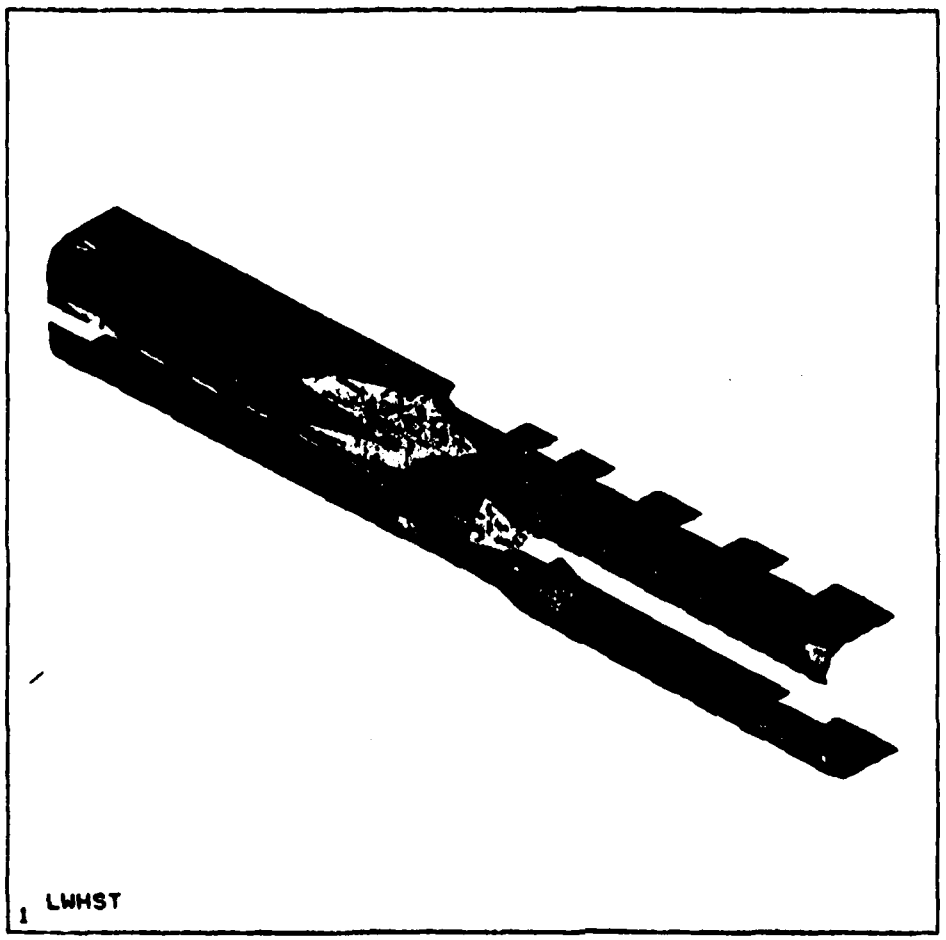
ANSYS 4.2B
FEB 14 1987
14:25:41
PLOT NO. 51
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=4939
MN=-22028
-19034
-16037
-13040
-10043
-7046



ANSYS 4.2B
FEB 14 1987
14:26:17
PLOT NO. 52
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=16810
MN=-22720
-18330
-13937
-9544
-5151
-758



ANSYS 4.2B
FEB 14 1987
14:26:50
PLOT NO. 53
POST1 STRESS
STEP=3
ITER=1
SXY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=15755
MN=-2553
-522
1513
3548
5583
7618

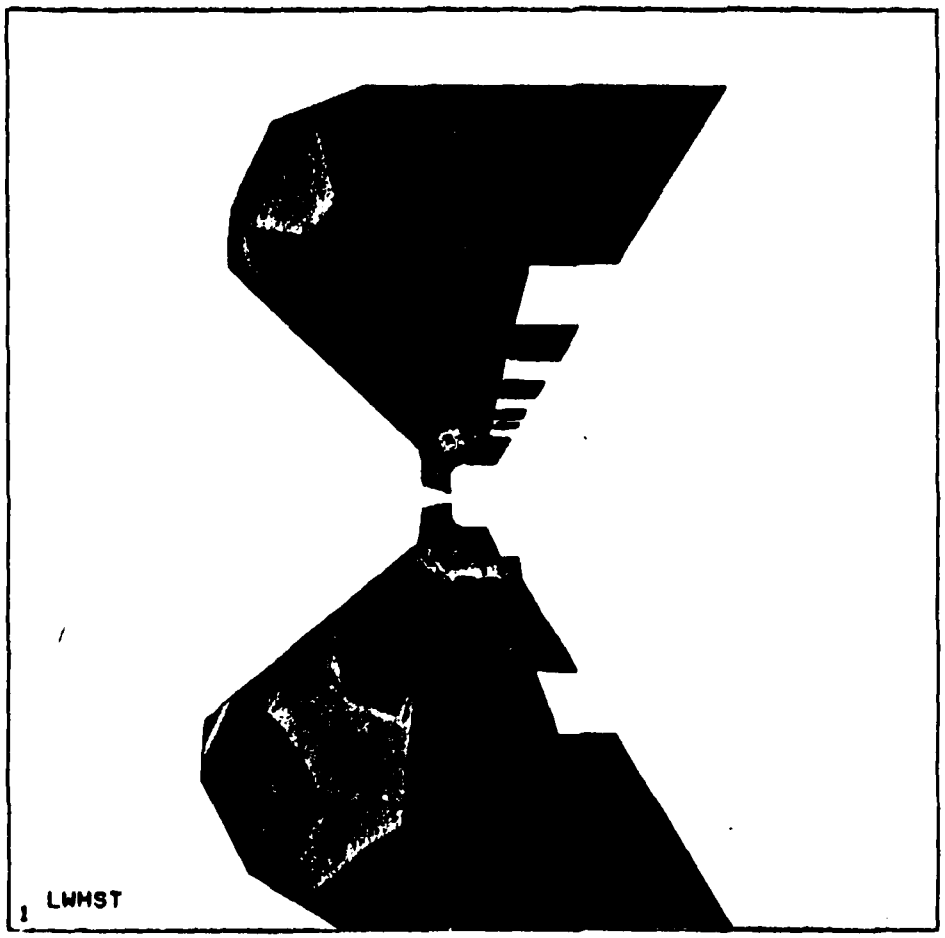
ANSYS 4.2B
FEB 14 1987
14:27:20
PLOT NO. 54
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=4939
MN=-22028
-19034
-16037
-13040
-10043
-7046
1945
4942

ANSYS 4.2B
FEB 14 1987
14:28:02
PLOT NO. 55
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

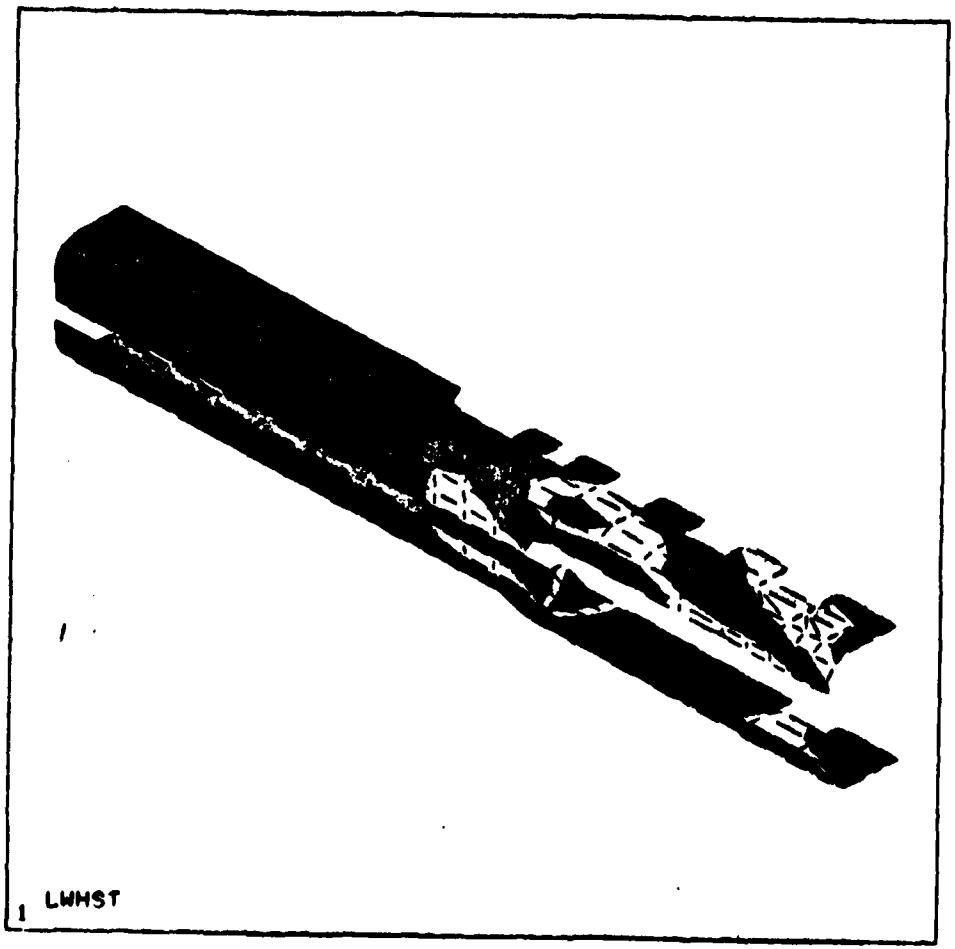
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=16810
MN=-22720
-18330
-13937
-9544
-5151
-758

12421
16814



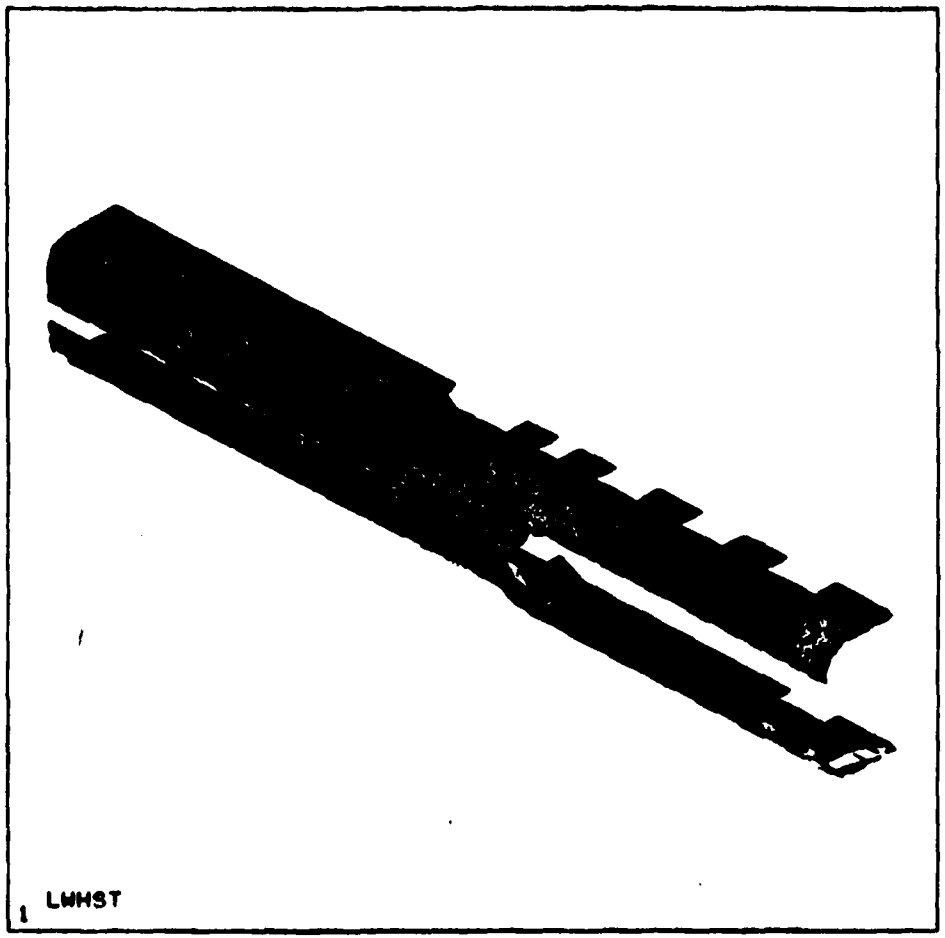
ANSYS 4.2B
FEB 14 1987
14:28:38
PLOT NO. 56
POST1 STRESS
STEP=3
ITER=1
SXY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=15755
MN=-2553
-522
1513
3548
5583
7618
.
.
.
13723
15758



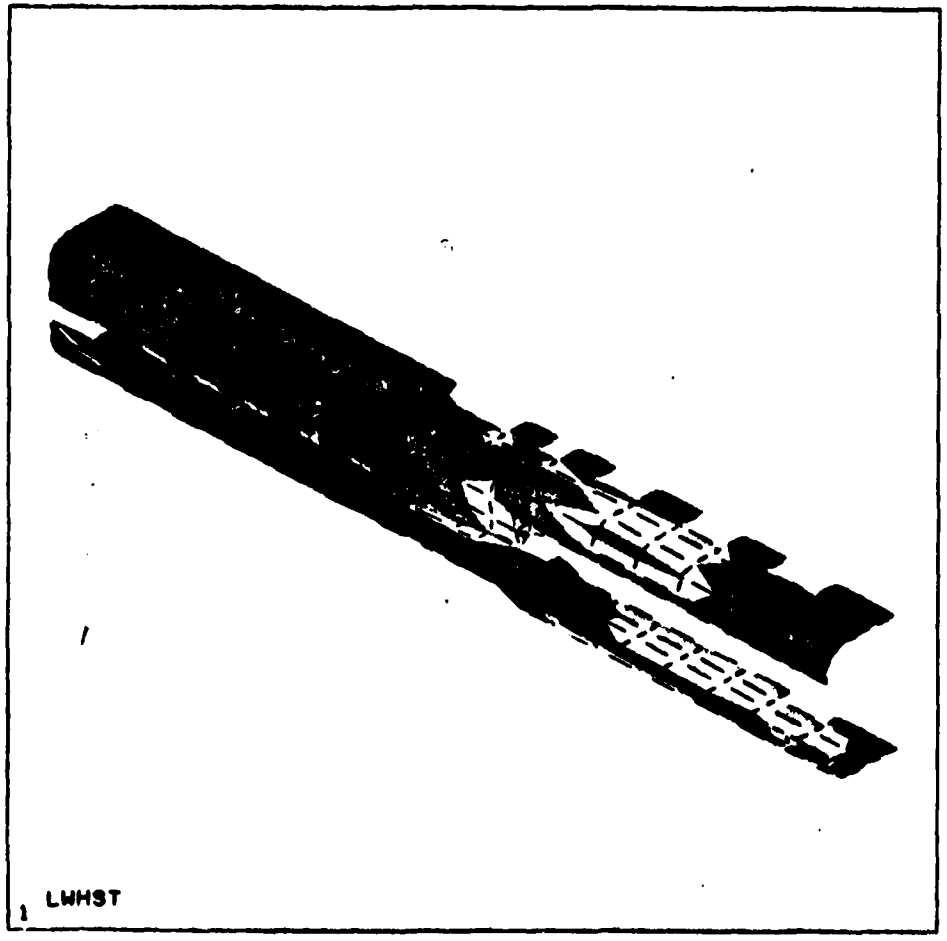
ANSYS 4.2B
FEB 14 1987
14:29:36
PLOT NO. 57
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=81.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=4606
MN=-22602
-19582
-16558
-13534
-10510
-7486



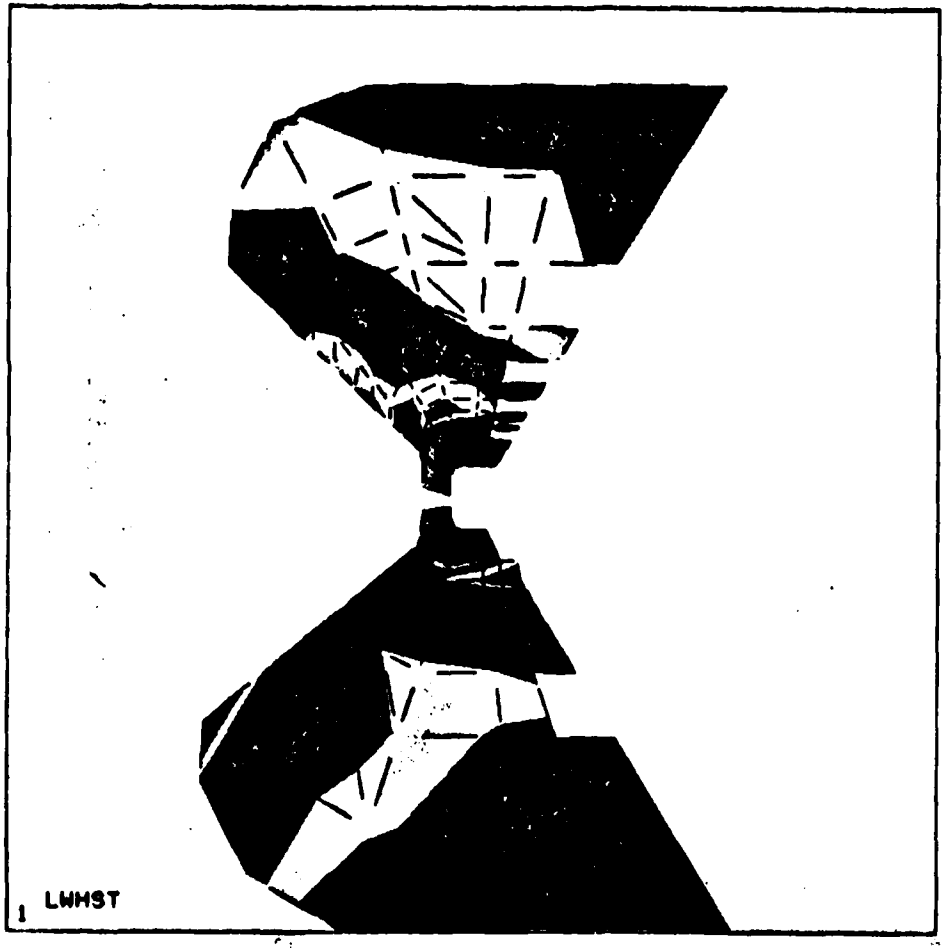
ANSYS 4.2B
FEB 14 1987
14:30:12
PLOT NO. 58
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=12375
MN=-12430
-9677
-6920
-4163
-1406
1351



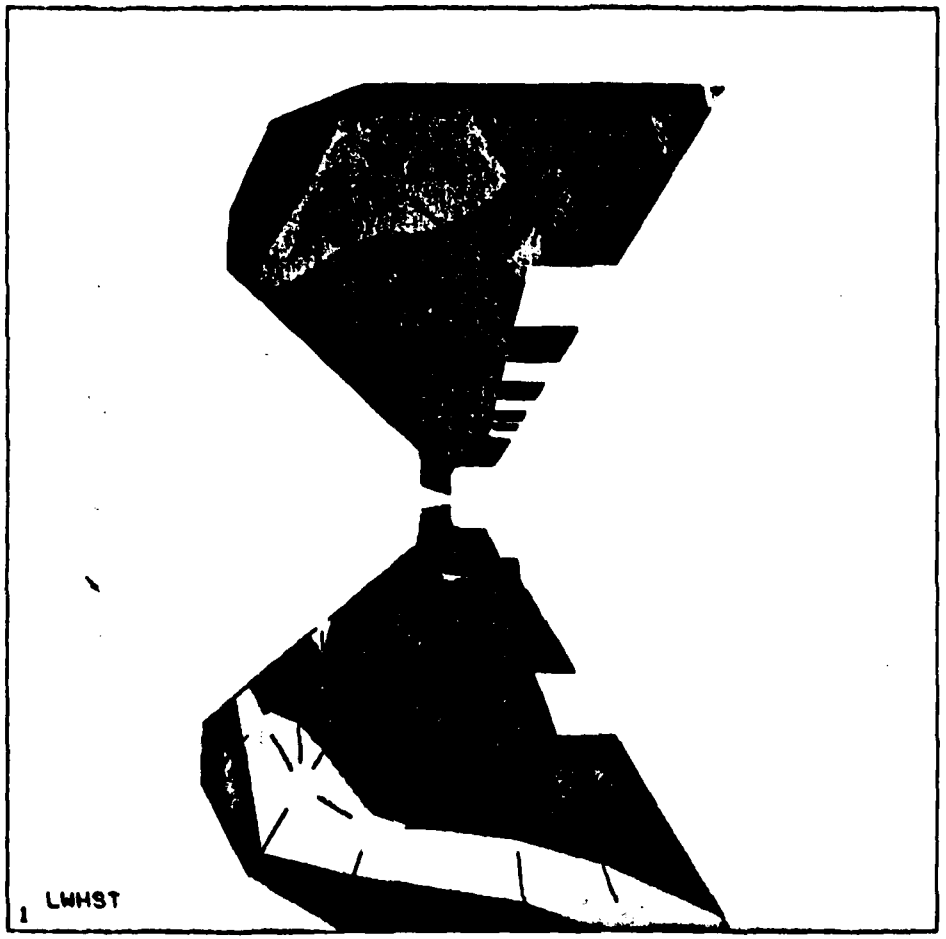
ANSYS 4.2B
FEB 14 1987
14:30:44
PLOT NO. 59
POST1 STRESS
STEP=3
ITER=1
SXY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=9413
MN=-10481
-8272
-6061
-3850
-1639
572



ANSYS 4.2B
FEB 14 1987
14:31:15
PLOT NO. 60
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

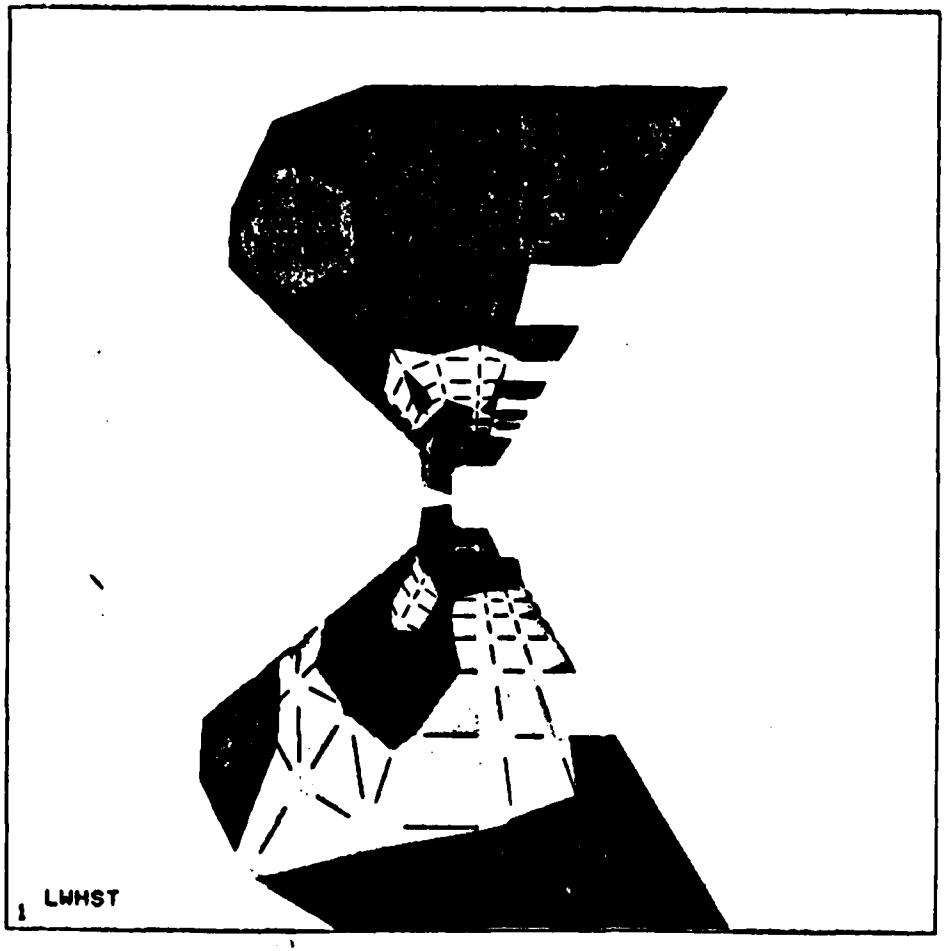
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=4606
MN=-22602
-19582
-16558
-13534
-10510
-7486
1586
4610



ANSYS 4.2B
FEB 14 1987
14:31:49
PLOT NO. 61
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

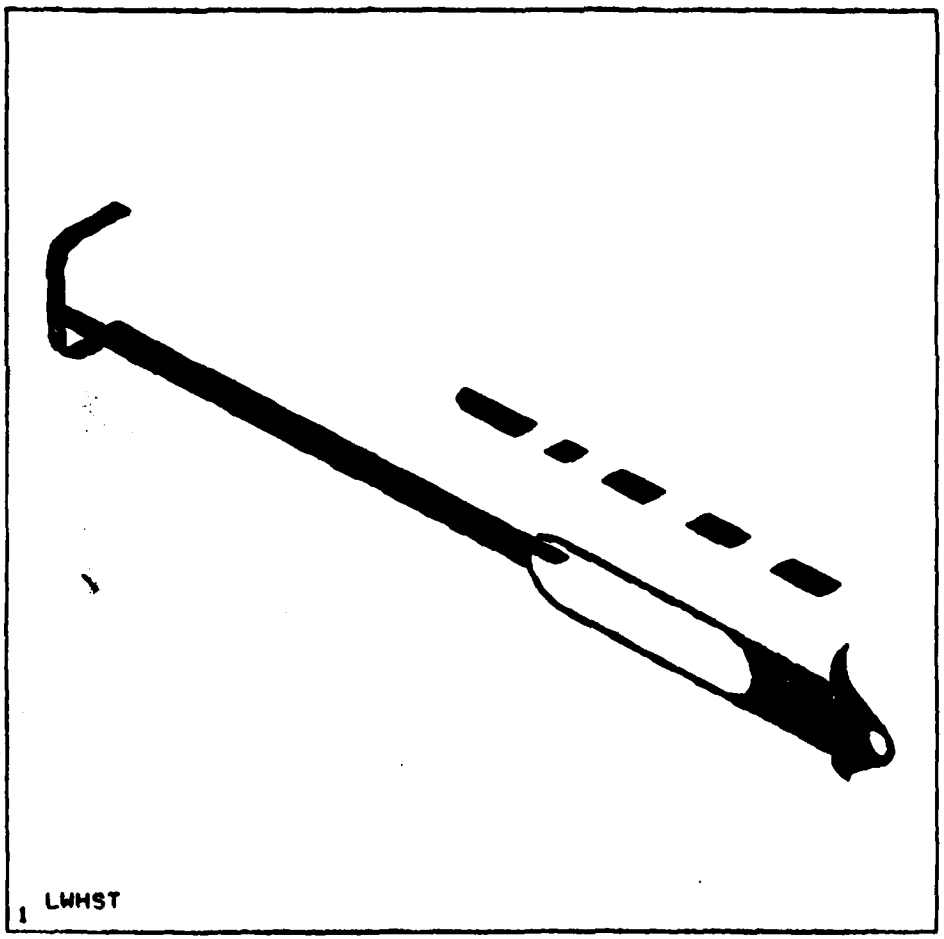
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=12375
MN=-12430
-9677
-6920
-4163
-1406
1351

9622
12379



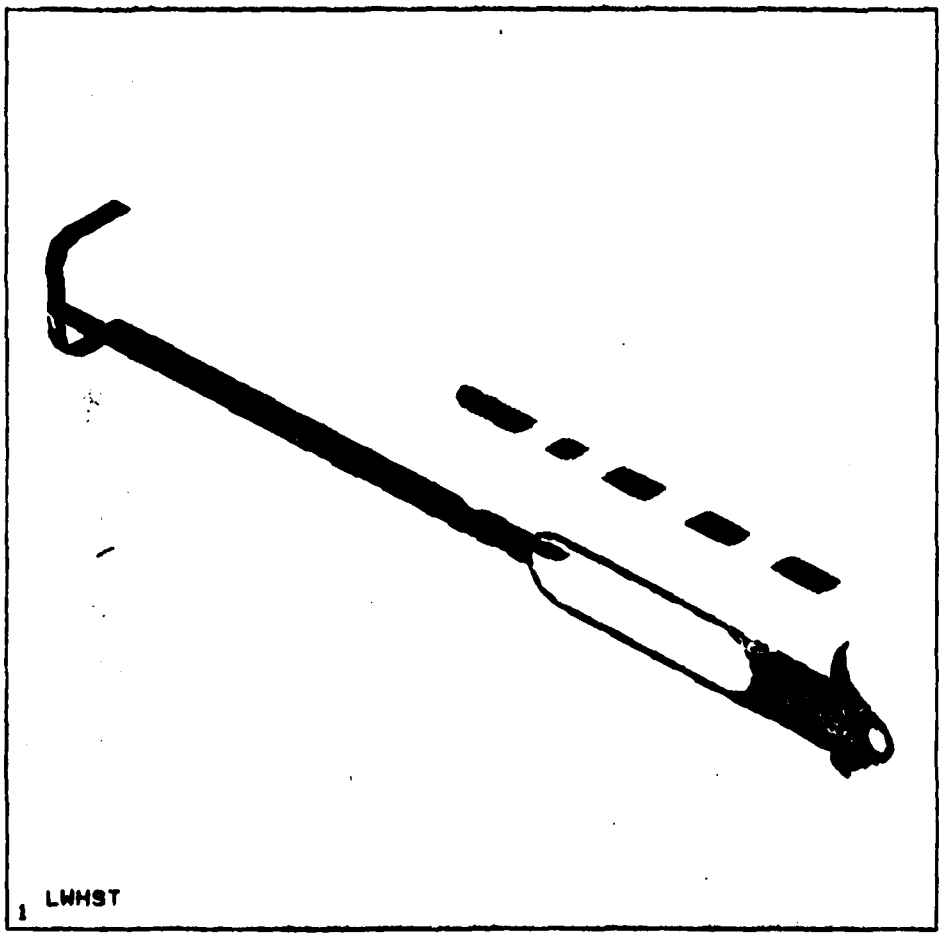
ANSYS 4.2B
FEB 14 1987
14:32:20
PLOT NO. 62
POST1 STRESS
STEP=3
ITER=1
SXY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=9413
MN=-10481
-8272
-6061
-3850
-1639
572
7205
9416



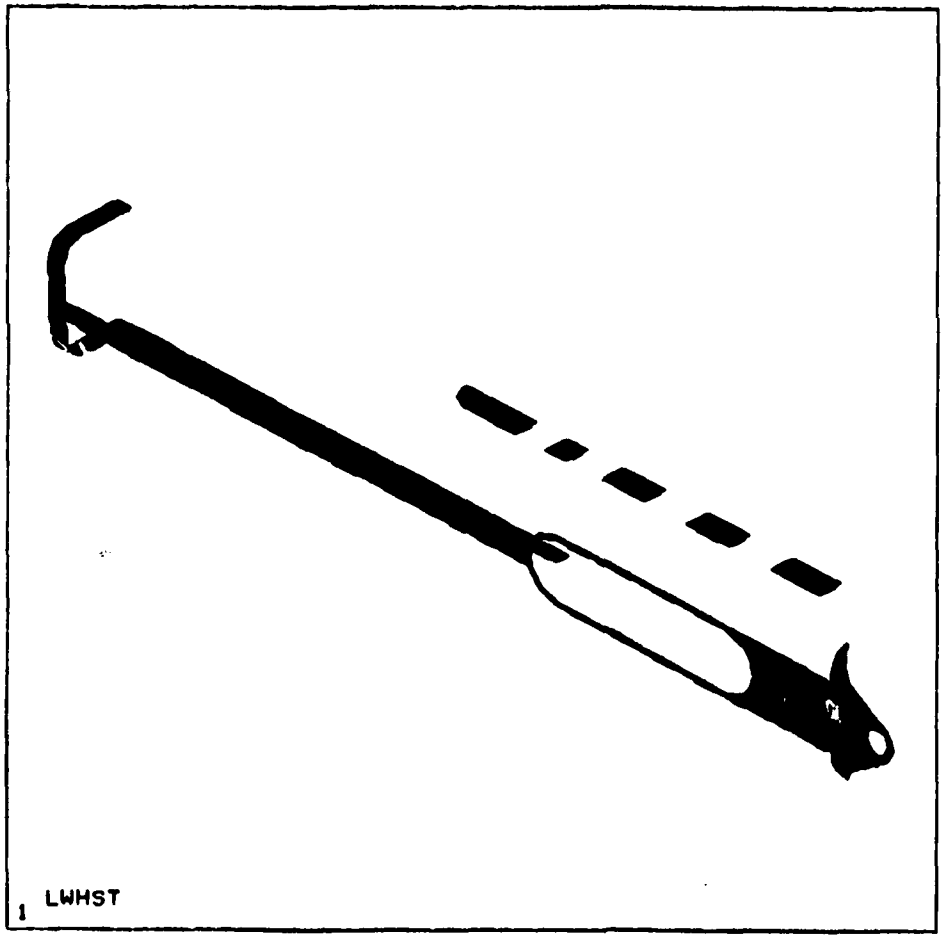
ANSYS 4.2B
FEB 14 1987
14:33:28
PLOT NO. 63
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=95647
MN=-103708
-81559
-59408
-37257
-15106
7045



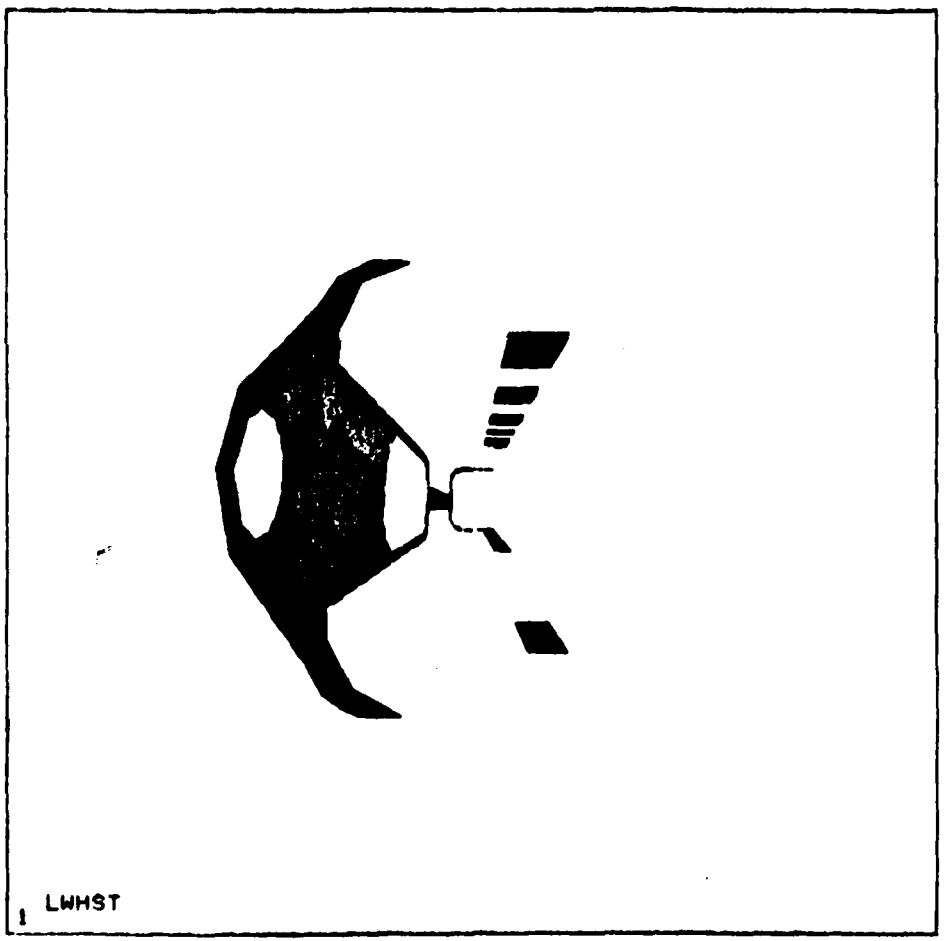
ANSYS 4.2B
FEB 14 1987
14:33:47
PLOT NO. 64
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=51572
MN=-78673
-64202
-49730
-35258
-20786
-6314



ANSYS 4.2B
FEB 14 1987
14:34:05
PLOT NO. 65
POST1 STRESS
STEP=3
ITER=1
SXY
TOP
STRESS ELEM CS

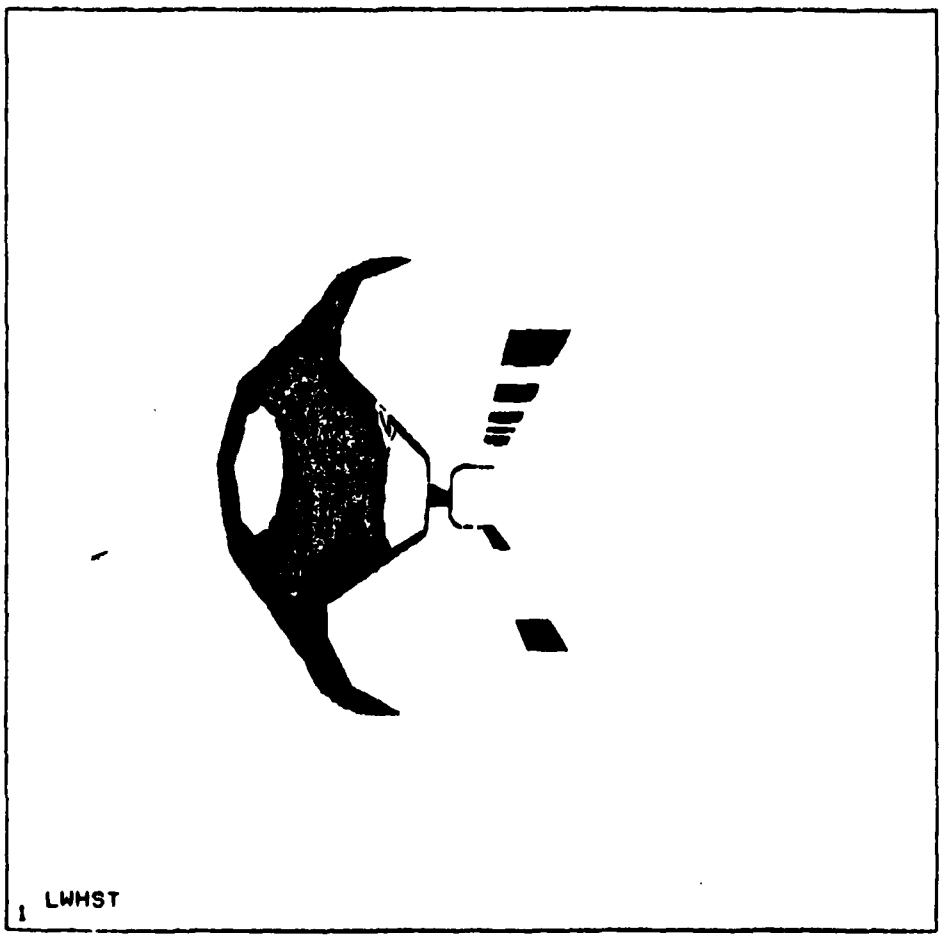
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=20908
MN=-17985
-13665
-9343
-5021
-699
3623



ANSYS 4.2B
FEB 14 1987
14:34:22
PLOT NO. 66
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=95647
MN=-103708
-81559
-59408
-37257
-15106
7045

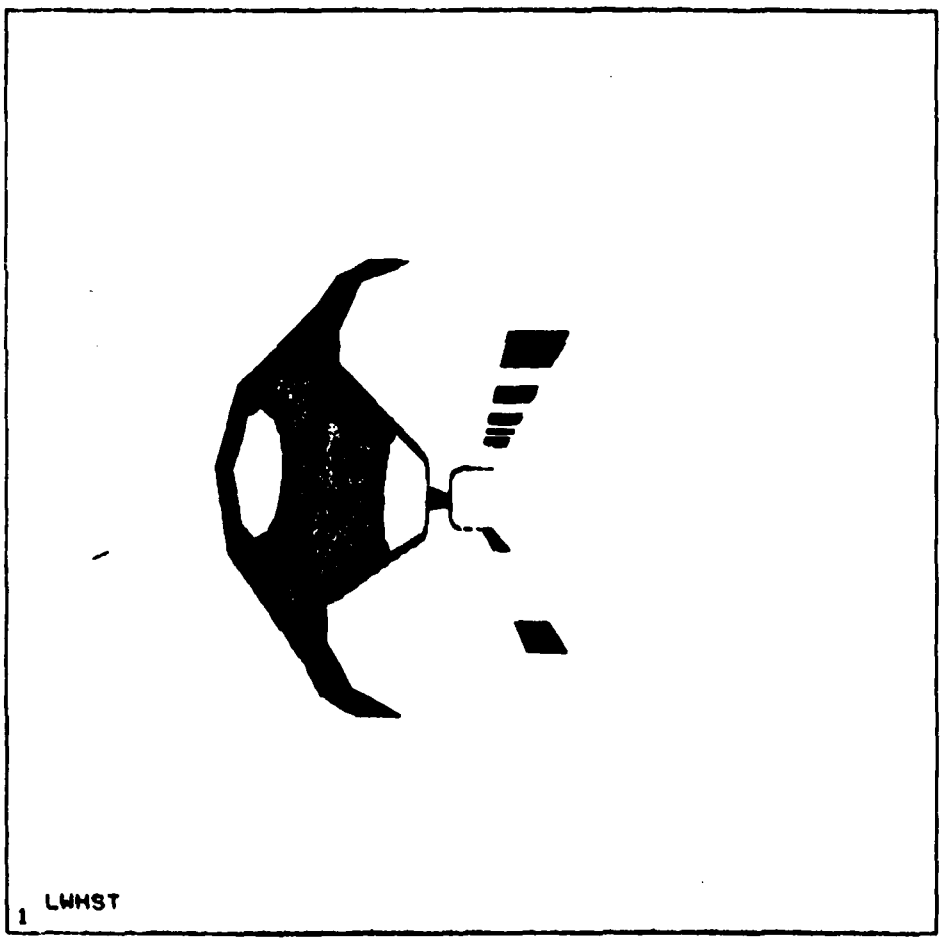
73498
95649



ANSYS 4.2B
FEB 14 1987
14:34:39
PLOT NO. 67
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=51572
MN=-78673
-64202
-49730
-35258
-20786
-6314

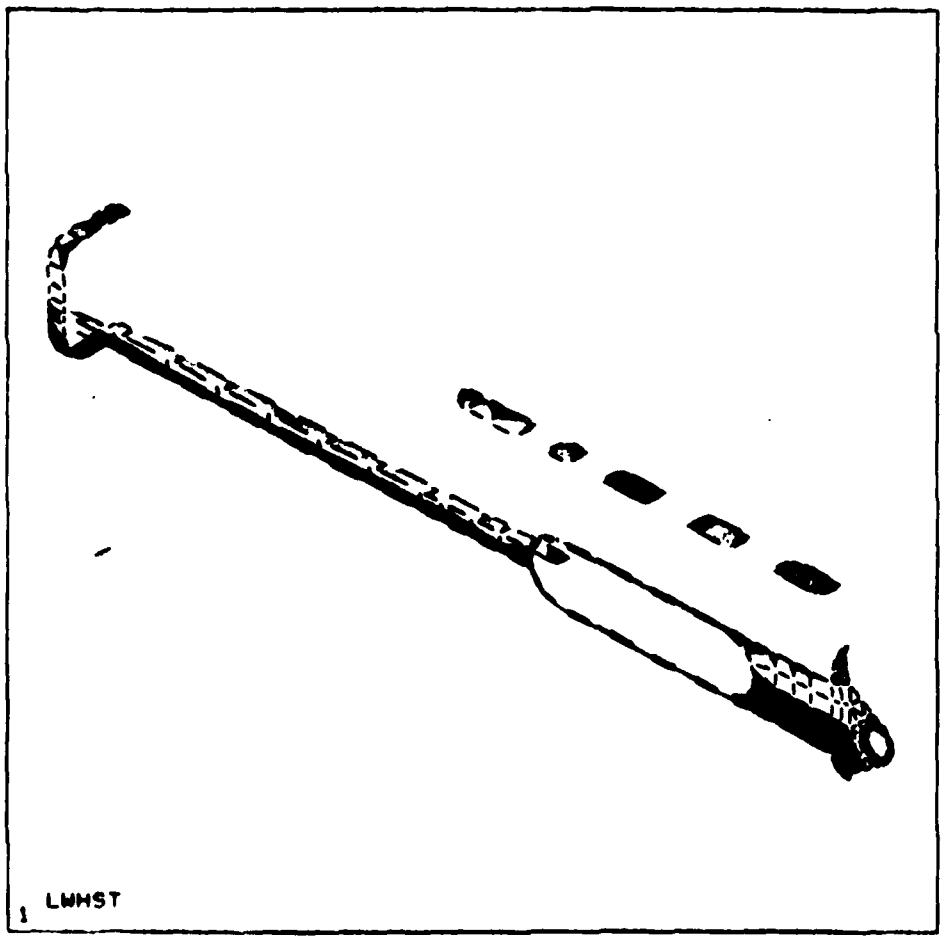
37102
51574



ANSYS 4.2B
FEB 14 1987
14:34:56
PLOT NO. 68
POST1 STRESS
STEP=3
ITER=1
SXY
TOP
STRESS ELEM CS

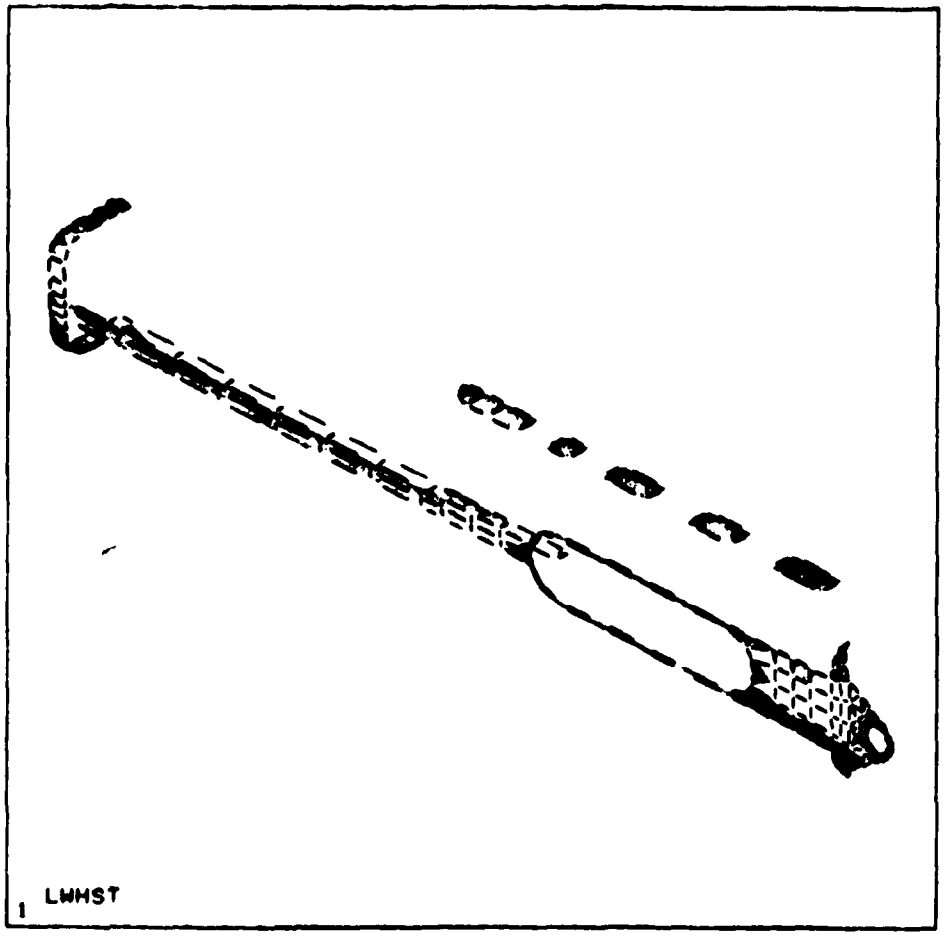
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=20908
MN=-17985
-13665
-9343
-5021
-699
3623

16589
20911



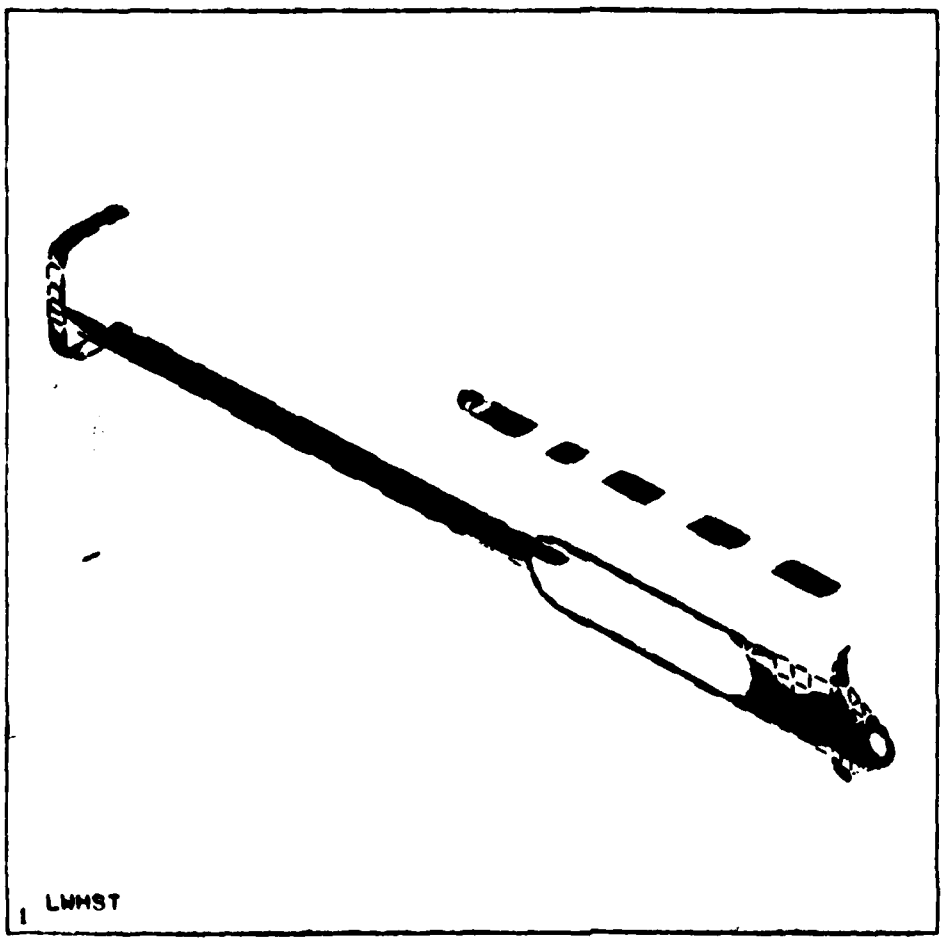
ANSYS 4.2B
FEB 14 1987
14:35:34
PLOT NO. 69
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=40424
MN=-138023
-118197
-98369
-78541
-58713
-38885



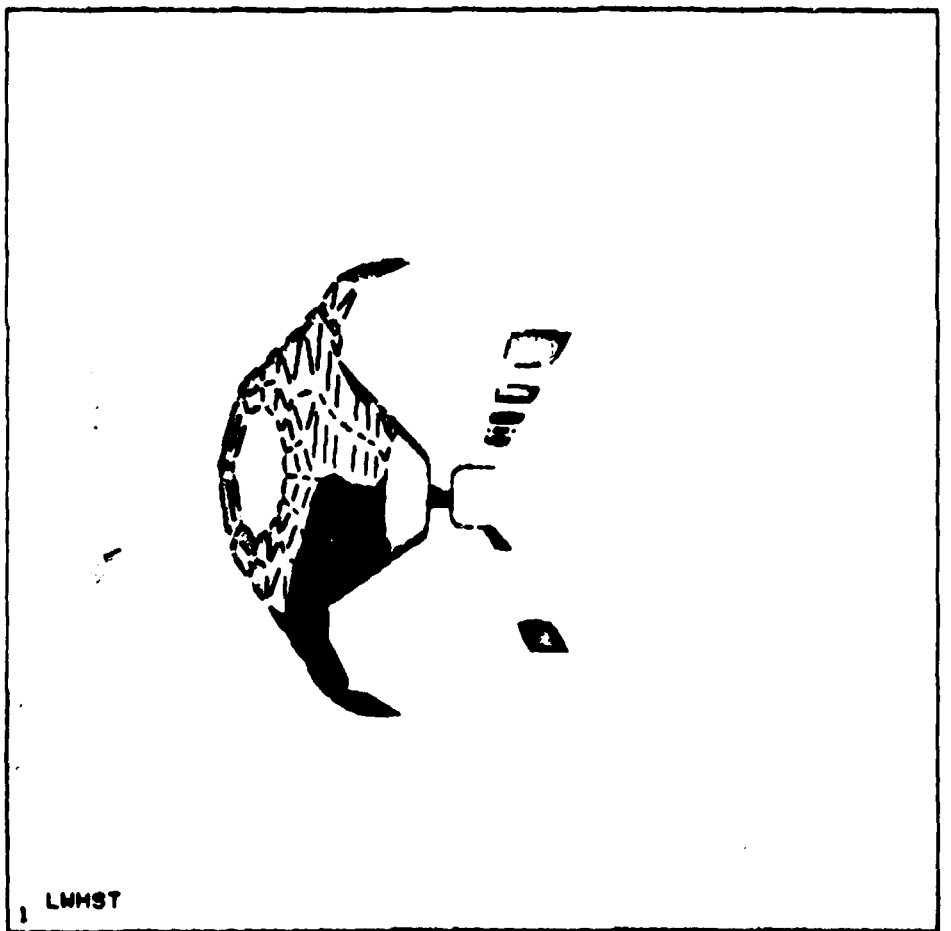
ANSYS 4.2B
FEB 14 1987
14:35:55
PLOT NO. 70
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=27001
MN=-100595
-86420
-72242
-58064
-43886
-29708



ANSYS 4.2B
FEB 14 1987
14:36:12
PLOT NO. 71
POST1 STRESS
STEP=3
ITER=1
SXY
BOTTOM
STRESS ELEM CS

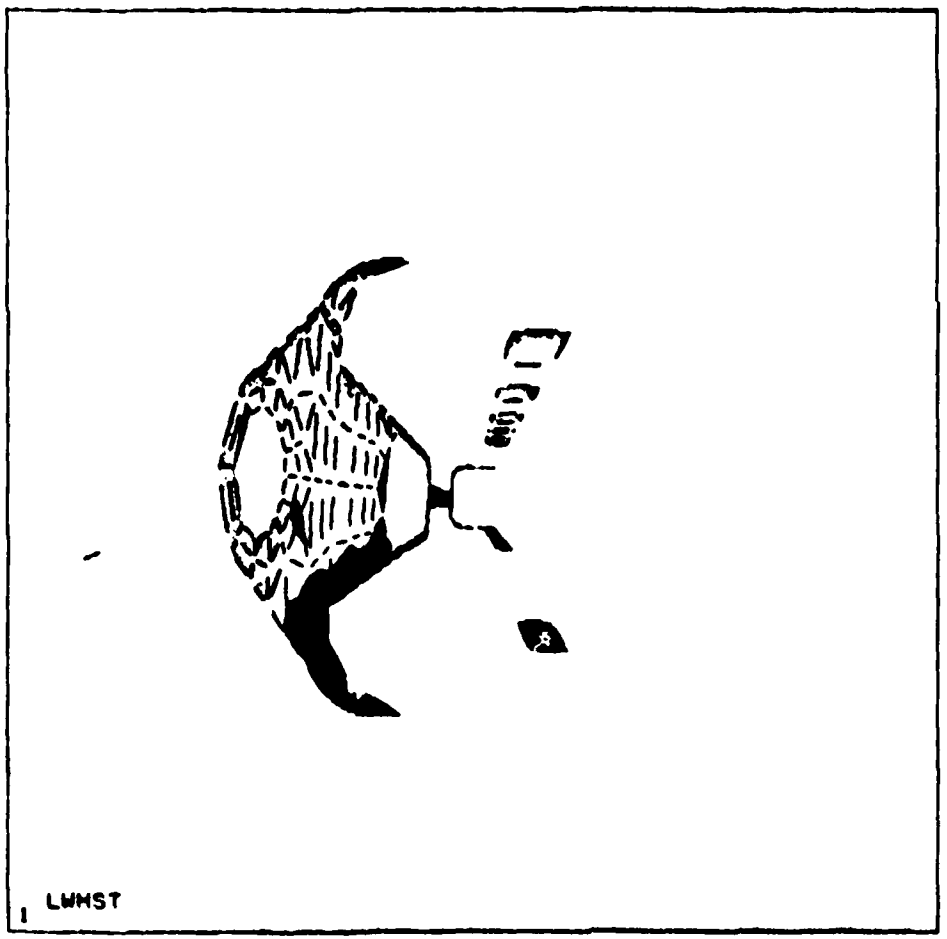
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=30622
MN=-62417
-52081
-41743
-31405
-21067
-10729



ANSYS 4.2B
FEB 14 1987
14:36:29
PLOT NO. 72
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=40424
MN=-138823
-118197
-98369
-78541
-58713
-38885

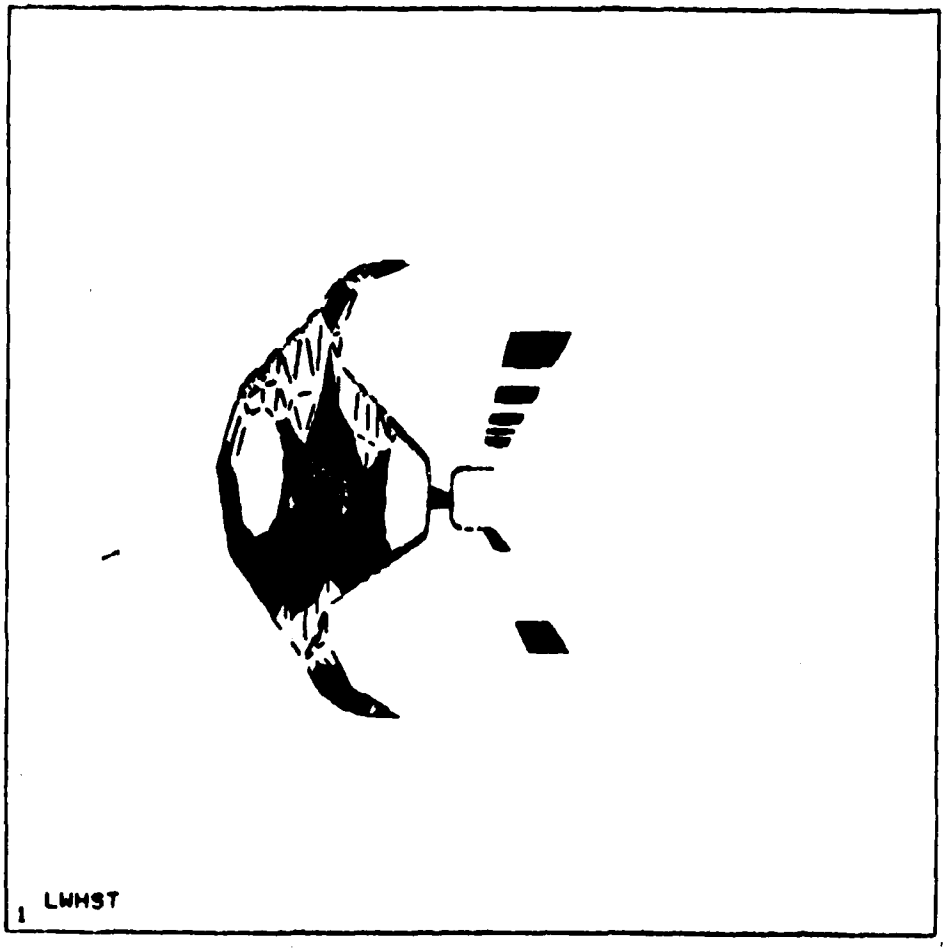
20599
40427



ANSYS 4.2B
FEB 14 1987
14:36:47
PLOT NO. 73
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=27001
MN=-100595
-86420
-72242
-58064
-43886
-29708

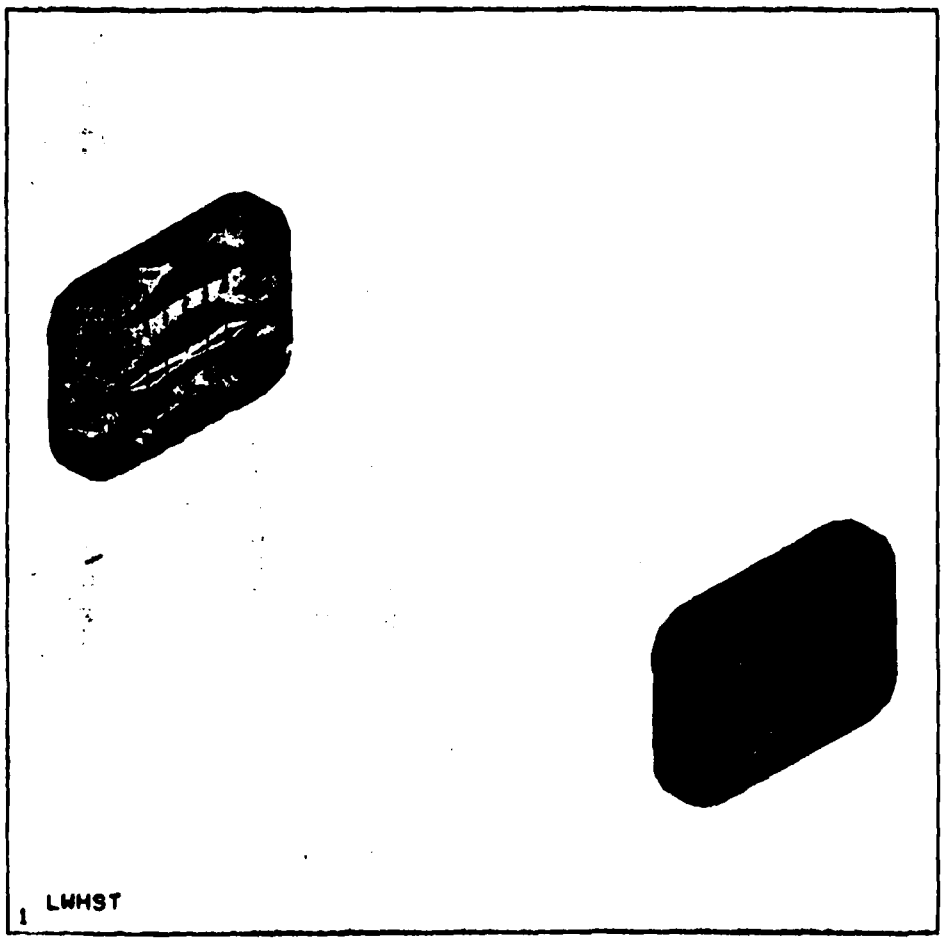
12826
27004



ANSYS 4.2B
FEB 14 1987
14:37:04
PLOT NO. 74
POST1 STRESS
STEP=3
ITER=1
SXY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=8.5
ZF=-119
CONE=40
HIDDEN
MX=30622
MN=-62417
-52081
-41743
-31405
-21067
-10729

20285
30623



ANSYS 4.2B
FEB 14 1987
14:38:01
PLOT NO. 75
POST1 STRESS
STEP=3
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2509
MN=12.8
288
566
844
1122
1400
[illegible]
[illegible]
2234
2512

D2/320

MCR MEMO: FEBRUARY 27, 1987

MCR
ASSOCIATES, INC.

111 W. Evelyn Ave., Suite 301
Sunnyvale, California 94086
(408) 736-1636

February 27, 1987

Larry Libhardt
FMC Corporation
3989 Central Ave NE
Minneapolis, Minn 55421

Model #13
3-2-87
LJL

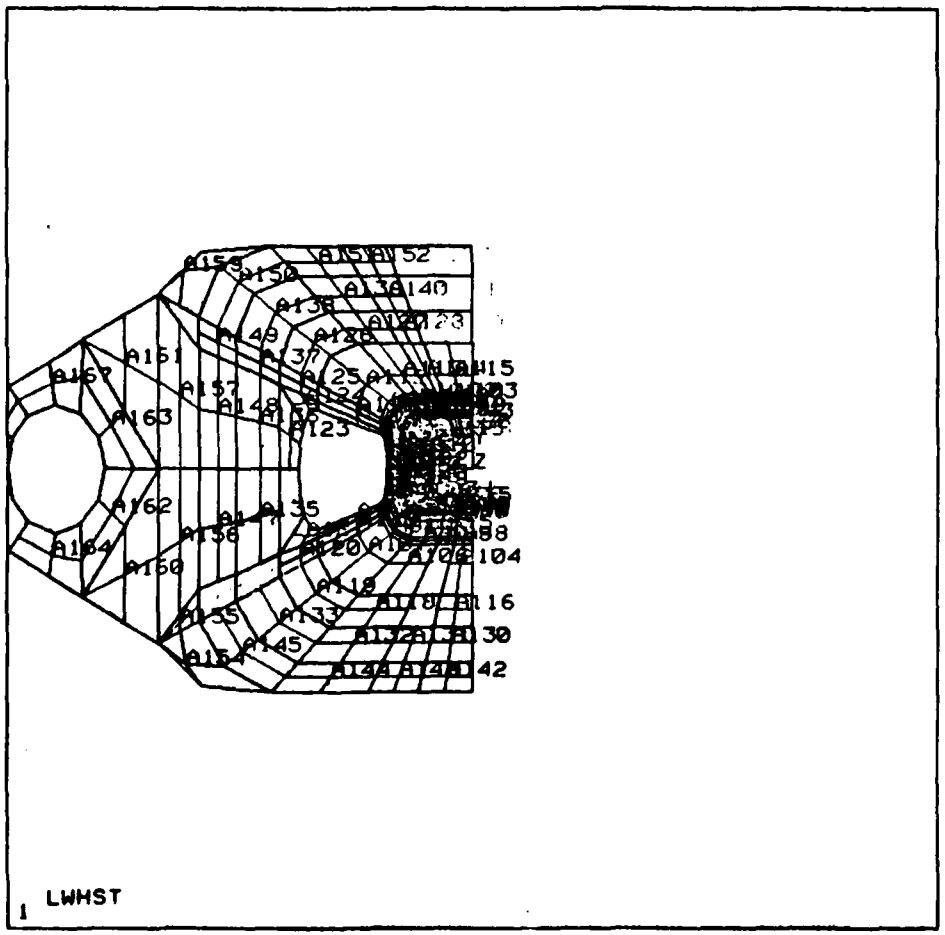
Dear Larry,

Enclosed is the input listing, stress contour plots and short results printout for model #13. The main changes that were made are that the core has been reduced from 2 inches to 1 inch. The connection between the front manifold and the shell was adjusted so that there is a full bearing surface in the Z direction only. There is a connection at the lower center of the manifold to the shell in the X and Y directions and a spring connects the upper center in the X direction with a spring constant of 1000 pounds/inch. Short beams were extended from the manifold out to an X value of + or - 23 inches and connected to the cables. Four load cases were run which consist of recoil, torque, gravity, and finally all three loads combined. The detailed printout is being sent and you should receive it the first week of March.

Best regards,

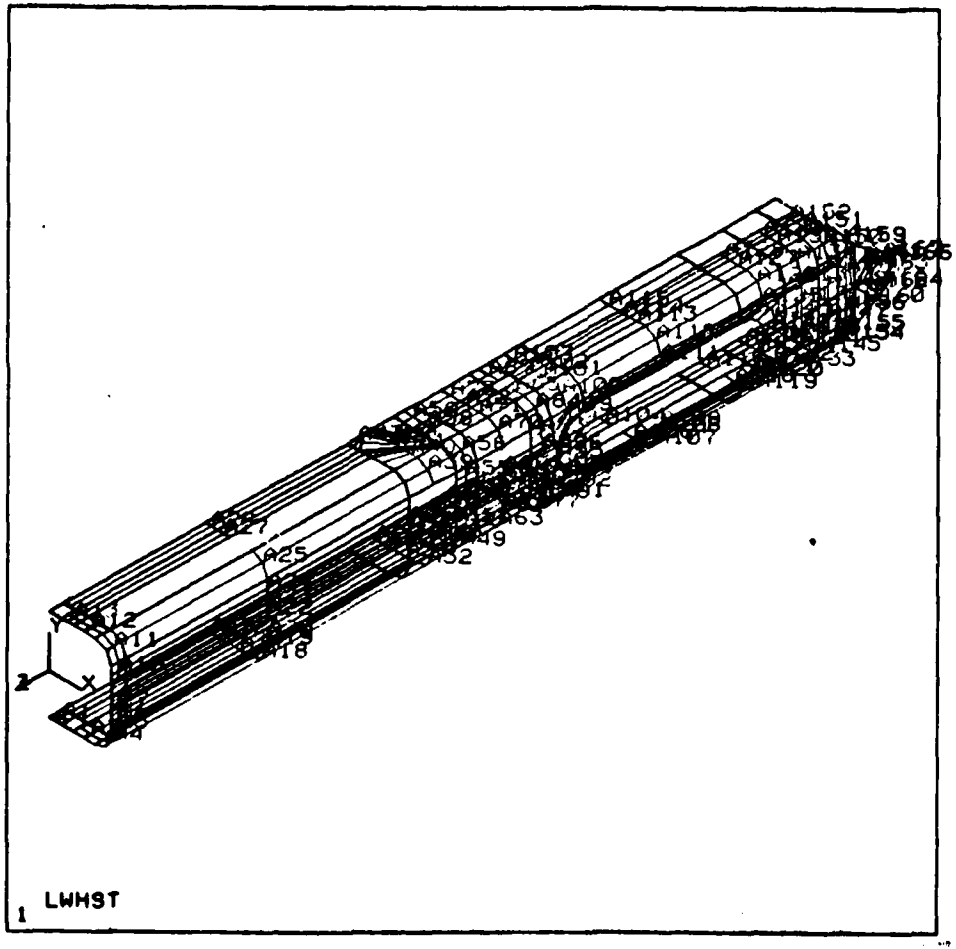
Mark C. Rodamaker

Mark C. Rodamaker



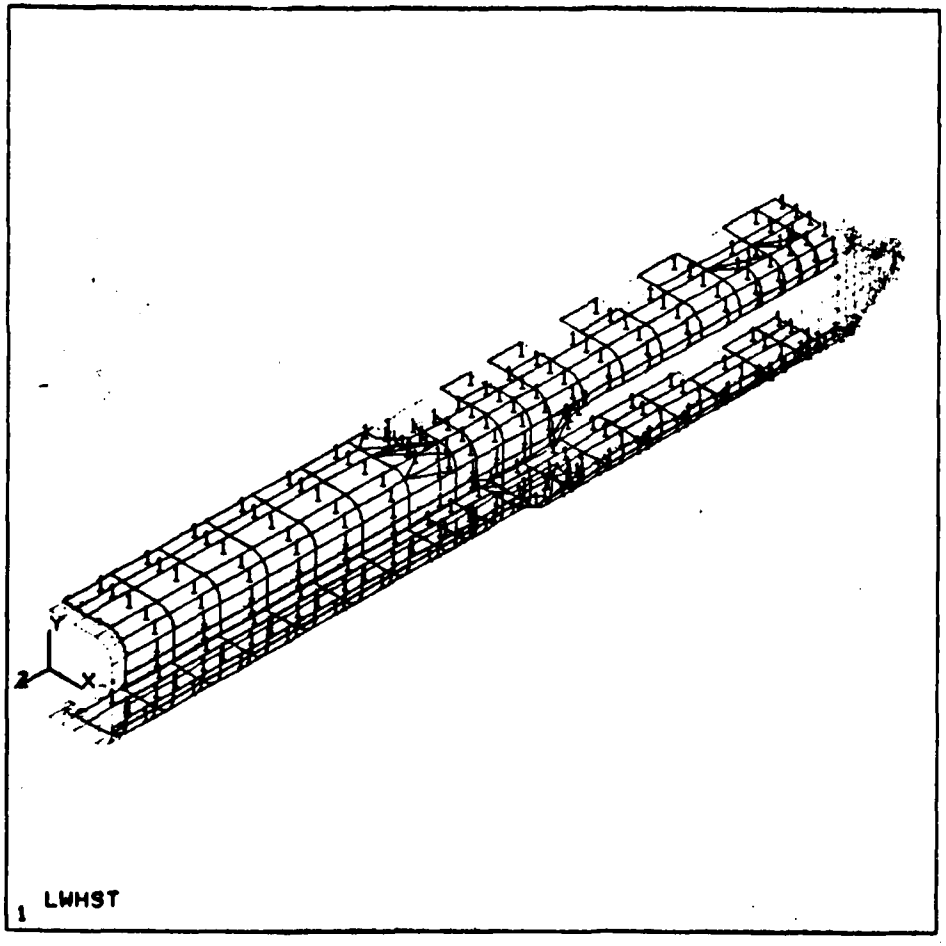
ANSYS 4.2B
FEB 26 1987
16:47:10
PLOT NO. 6
PREP7 AREAS

ZV=-1
# DIST=139
# ZF=-119
CONE=40



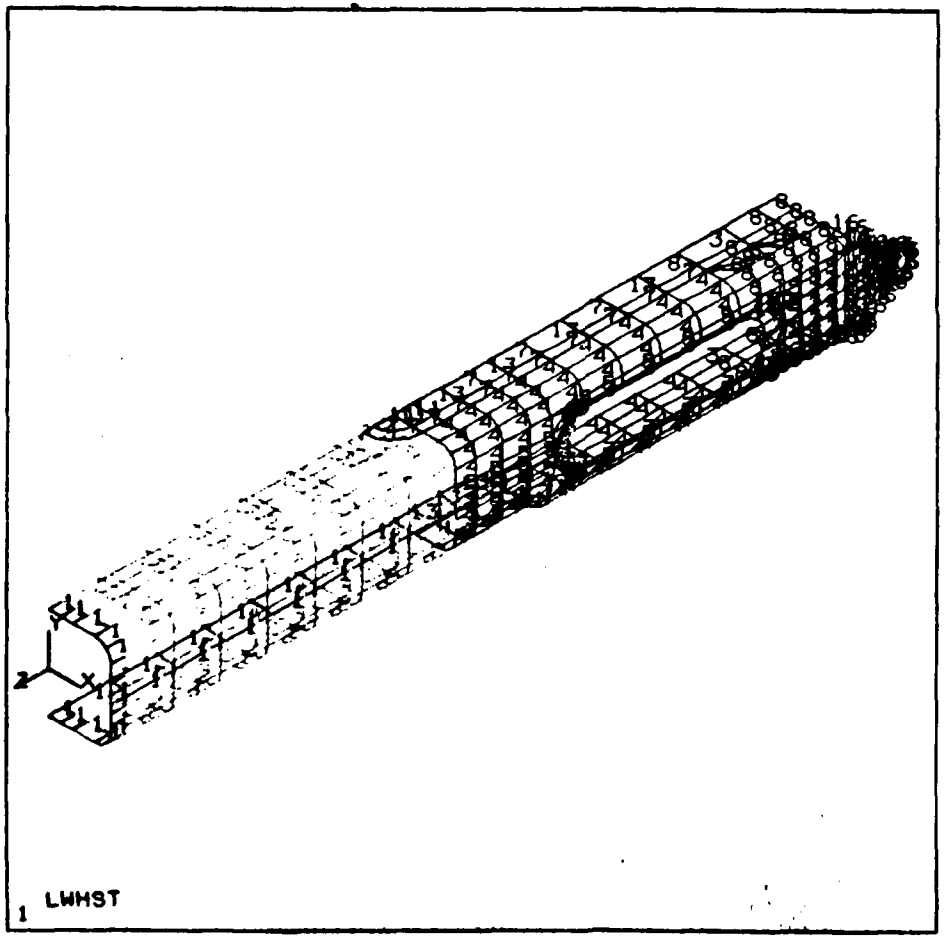
ANSYS 4.2B
FEB 26 1987
18:45:52
PLOT NO. 3
PREP7 AREAS

XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.33
ZF=-116



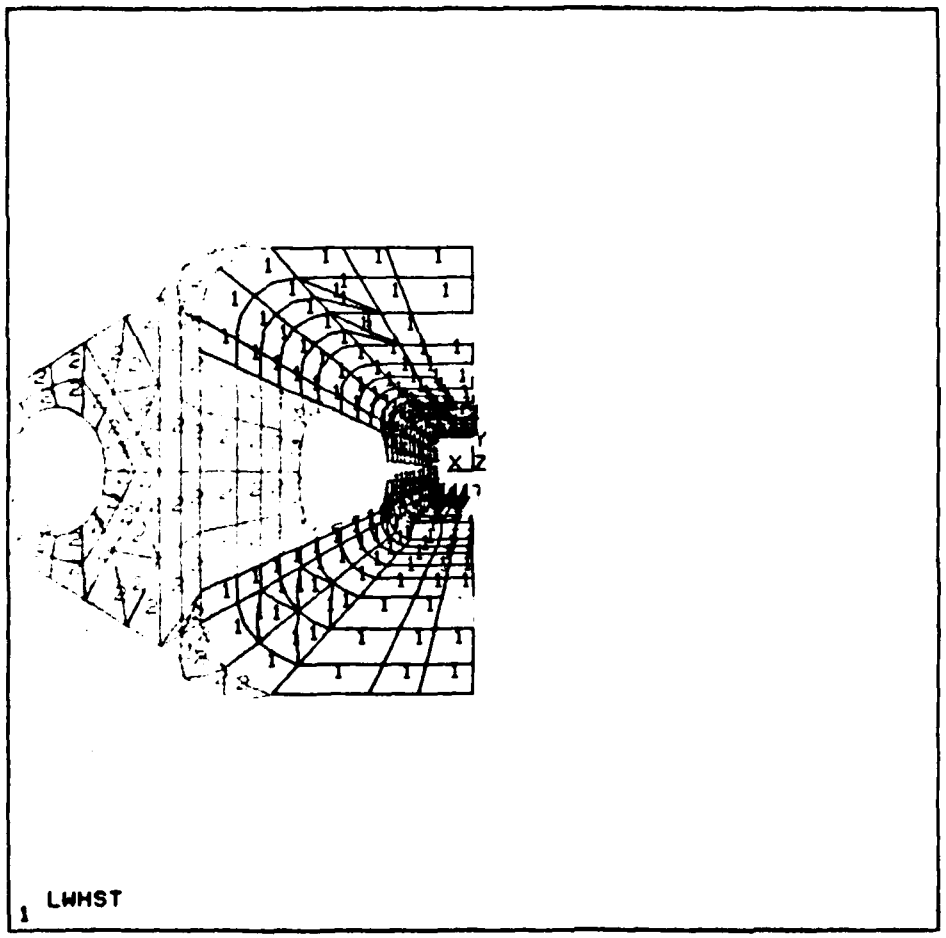
ANSYS 4.2B
FEB 26 1987
18:45:17
PLOT NO. 1
PREP7 ELEMENTS
TNUM=1

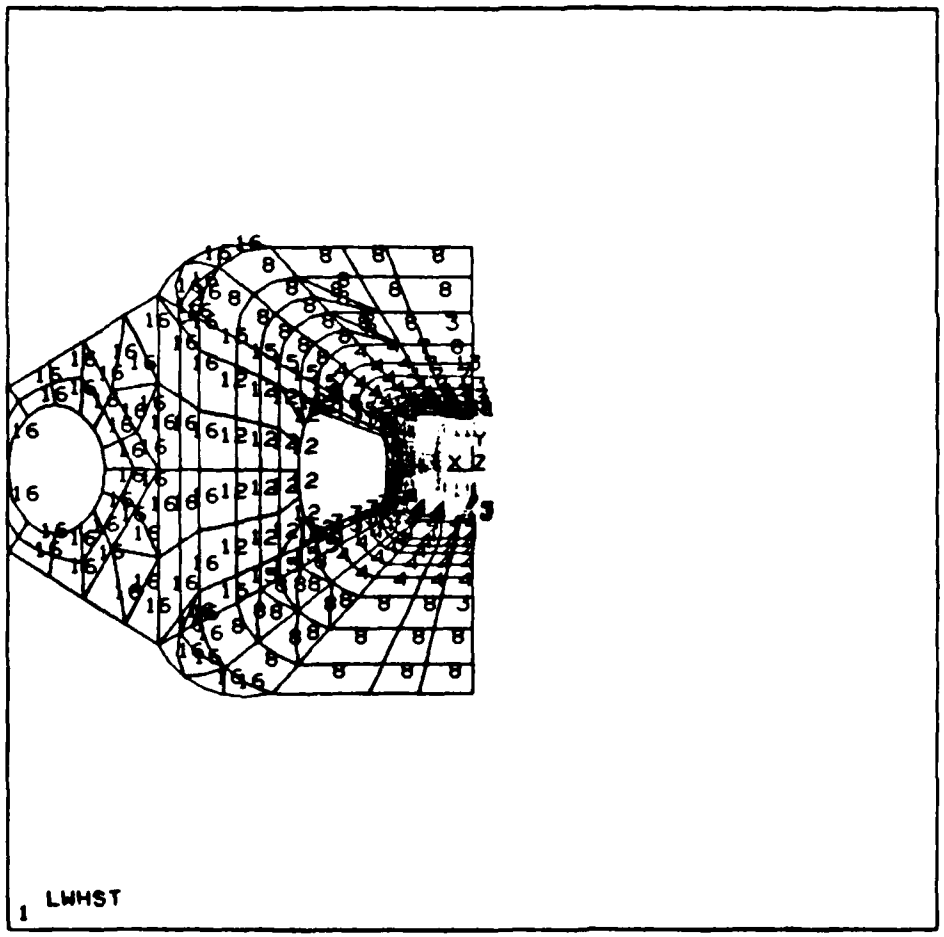
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115



ANSYS 4.2B
FEB 26 1987
18:45:37
PLOT NO. 2
PREP7 ELEMENTS
RNUM=1

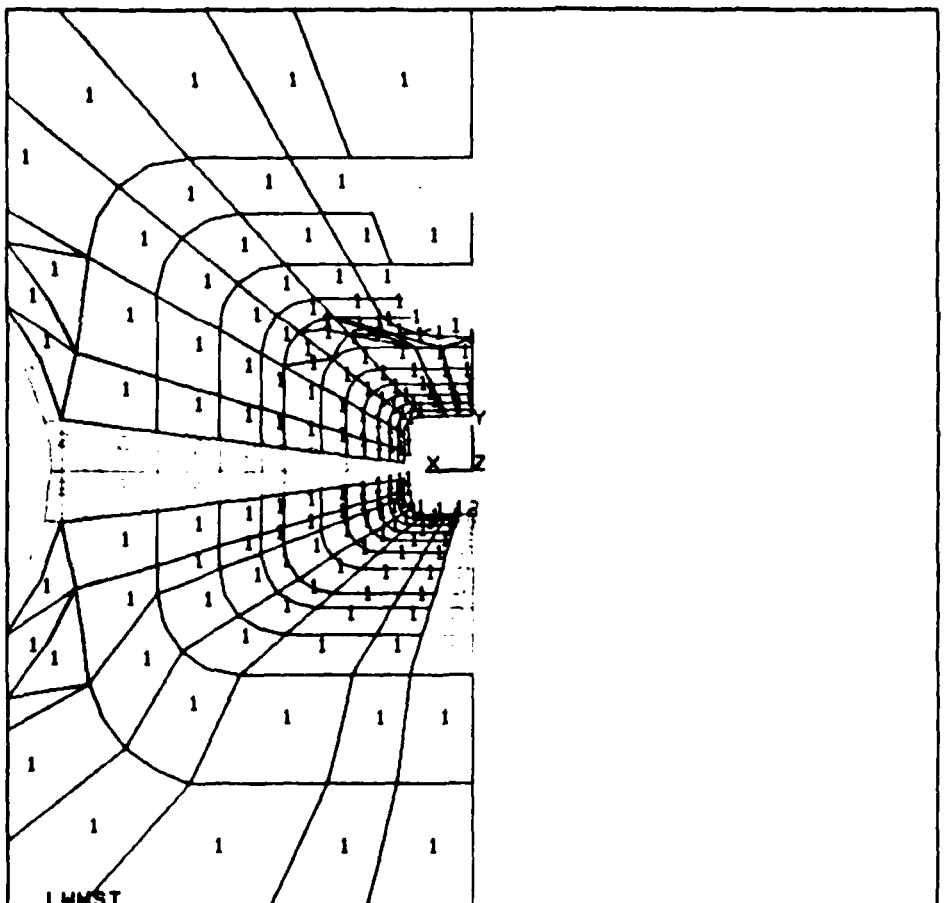
XV=1
YV=1
ZV=1
DIST=99.6
XF=12.5
YF=1.24
ZF=-115


ANSYS 4.2B
FEB 26 1987
18:46:25
PLOT NO. 4
PREP7 ELEMENTS
TNUM=1
ZV=-1
* DIST=139
* ZF=-119
CONE=40
Y
X Z
1 LWHST



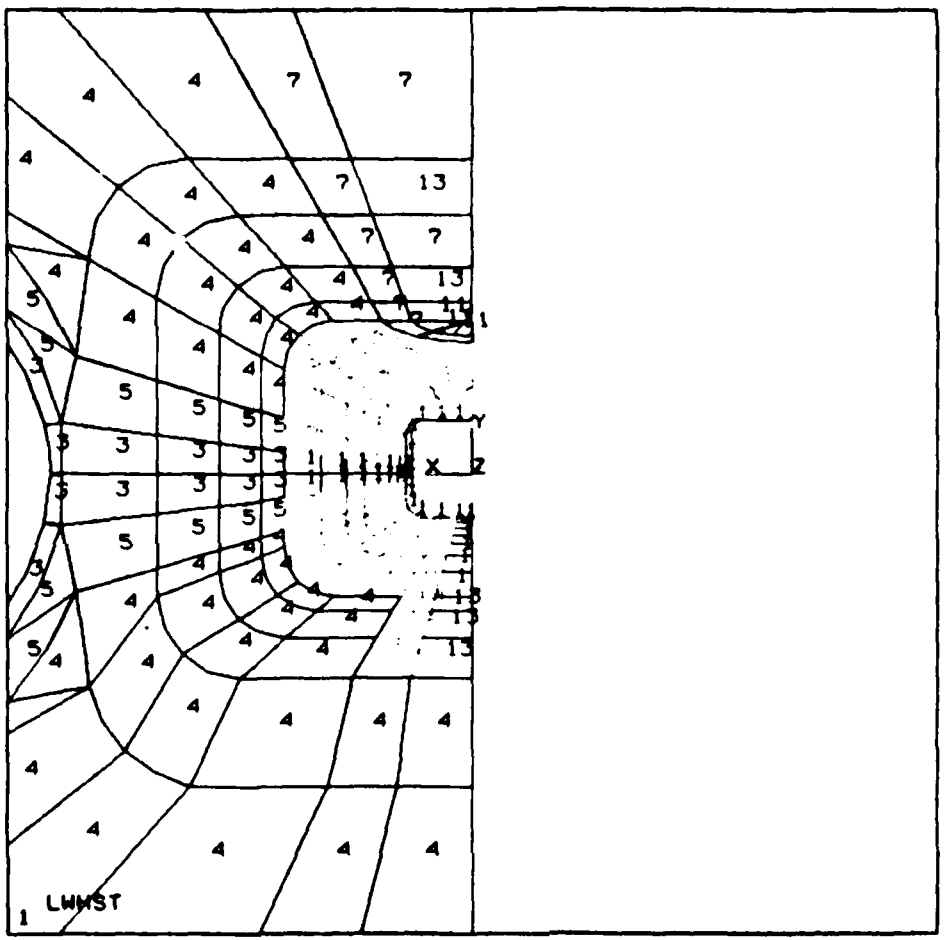
ANSYS 4.2B
FEB 26 1987
18:46:41
PLOT NO. 5
PREP7 ELEMENTS
RNUM=1

ZV=-1
* DIST=139
* ZF=-119
CONE=40



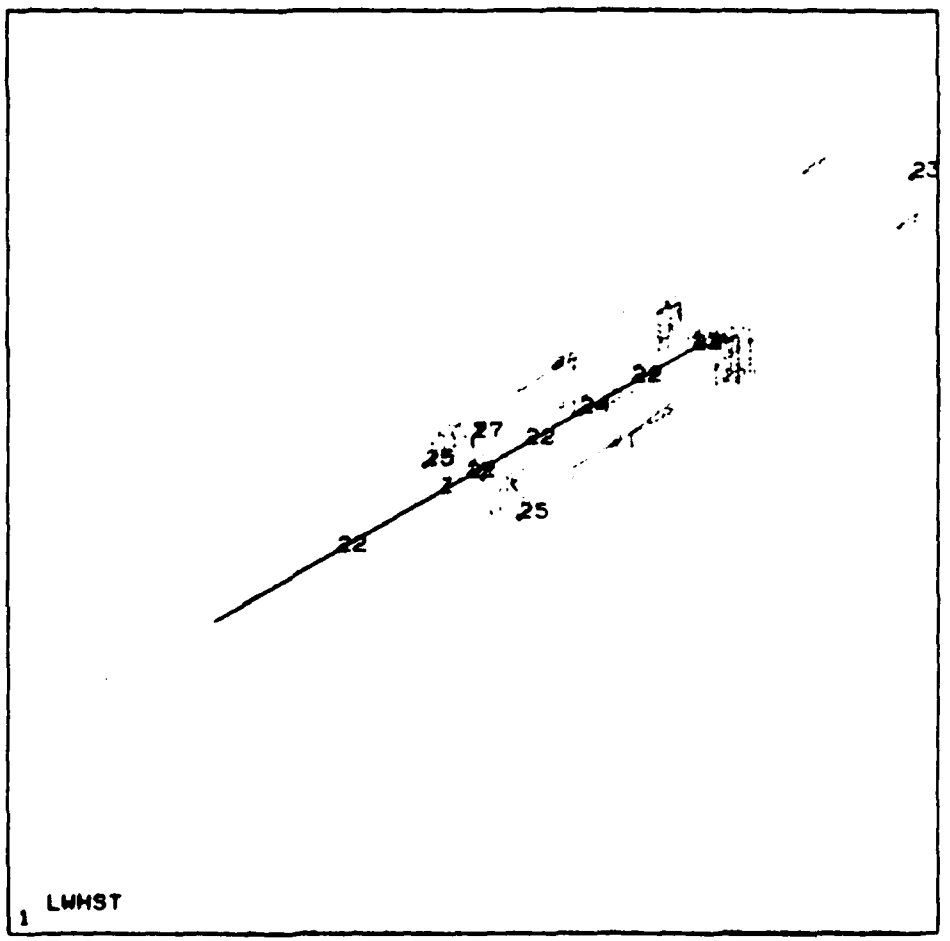
ANSYS 4.2B
FEB 26 1987
18:46:56
PLOT NO. 6
PREP7 ELEMENTS
TNUM=1

ZV=-1
* DIST=160
CONE=40



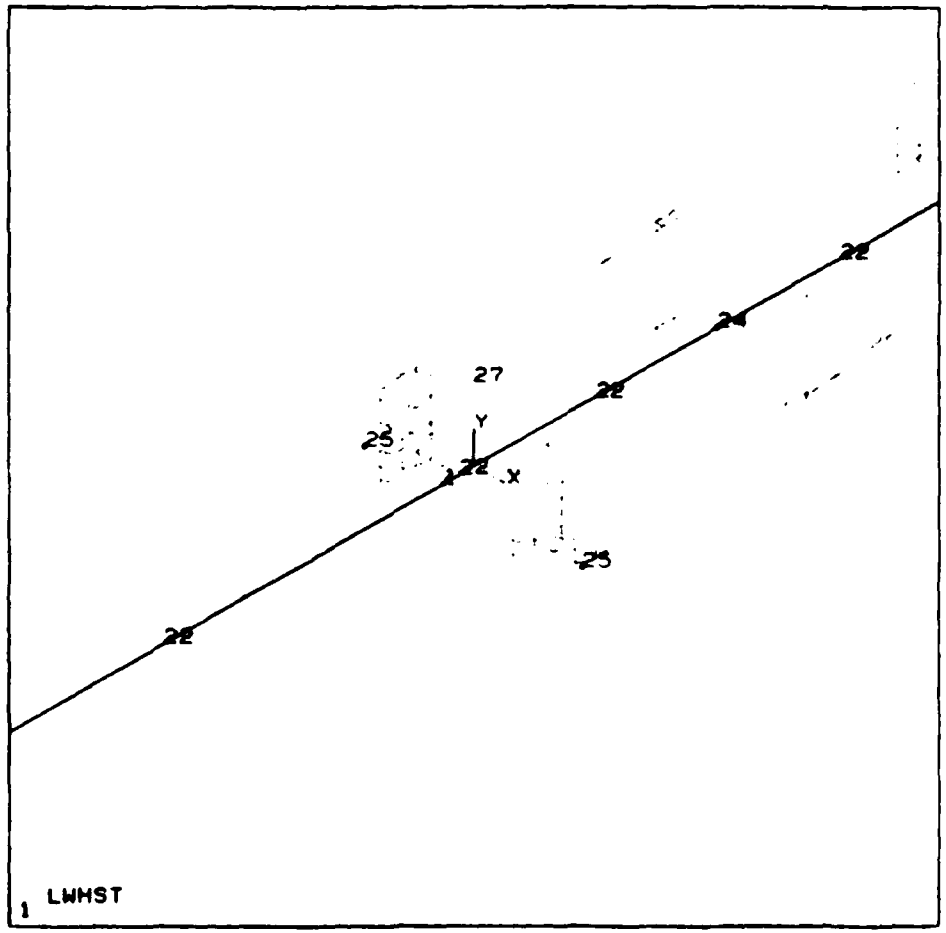
ANSYS 4.2B
FEB 26 1987
18:47:07
PLOT NO. 7
PREP7 ELEMENTS
RNUM=1

ZV=-1
* DIST=160
CONE=40



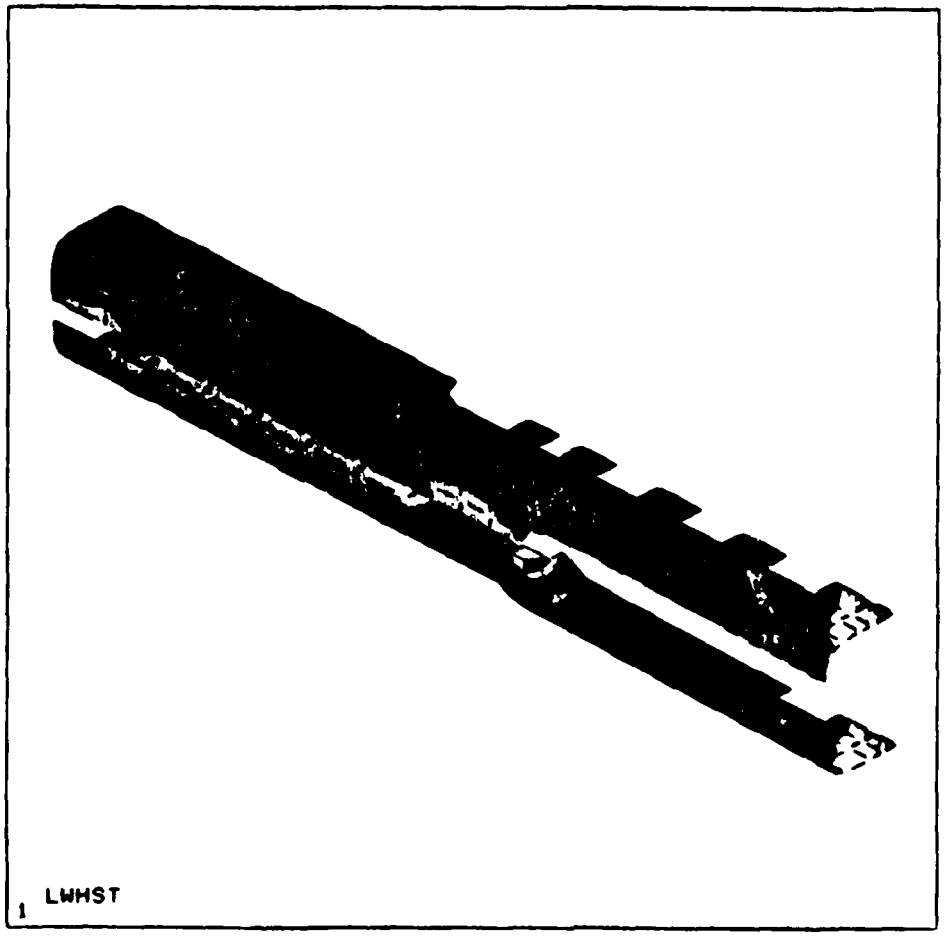
ANSYS 4.2B
FEB 26 1987
18:47:20
PLOT NO. 8
PREP7 ELEMENTS
RNUM=1

XV=1
YV=1
ZV=1
# DIST=160



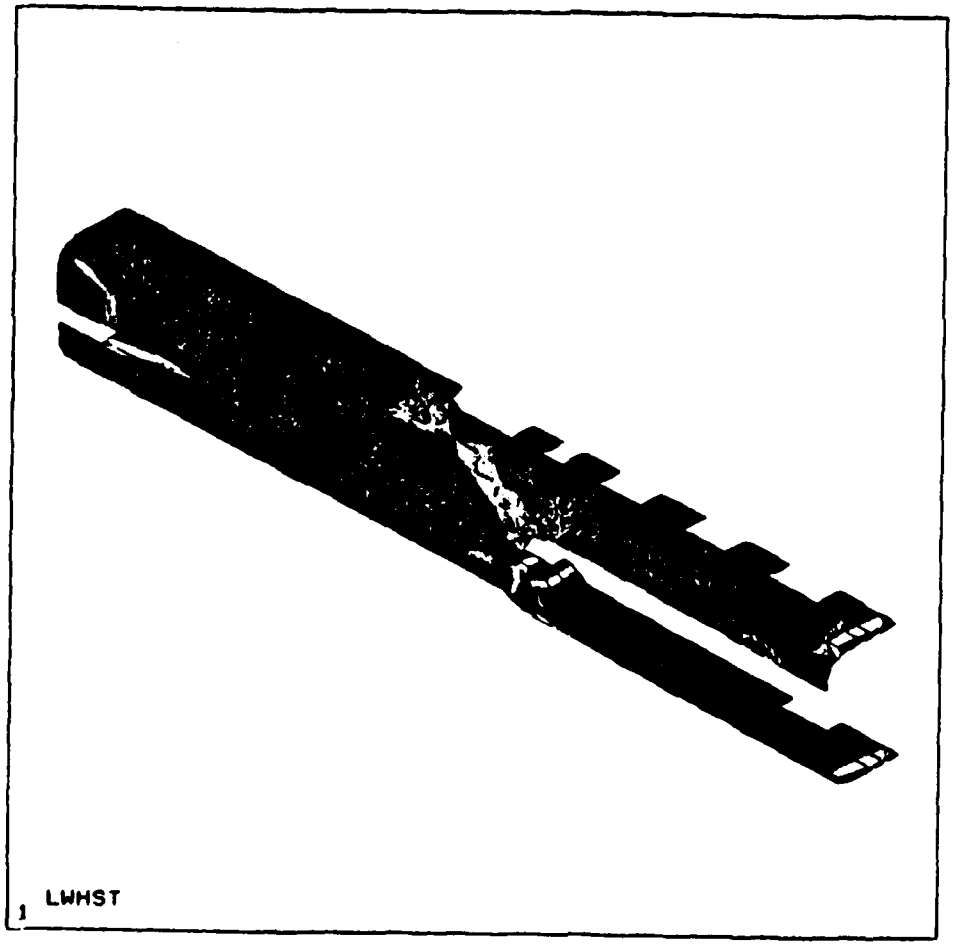
ANSYS 4.2B
FEB 26 1987
16:47:20
PLOT NO. 8
PREP7 ELEMENTS
RNUM=1

XV=1
YV=1
ZV=1
DIST=70



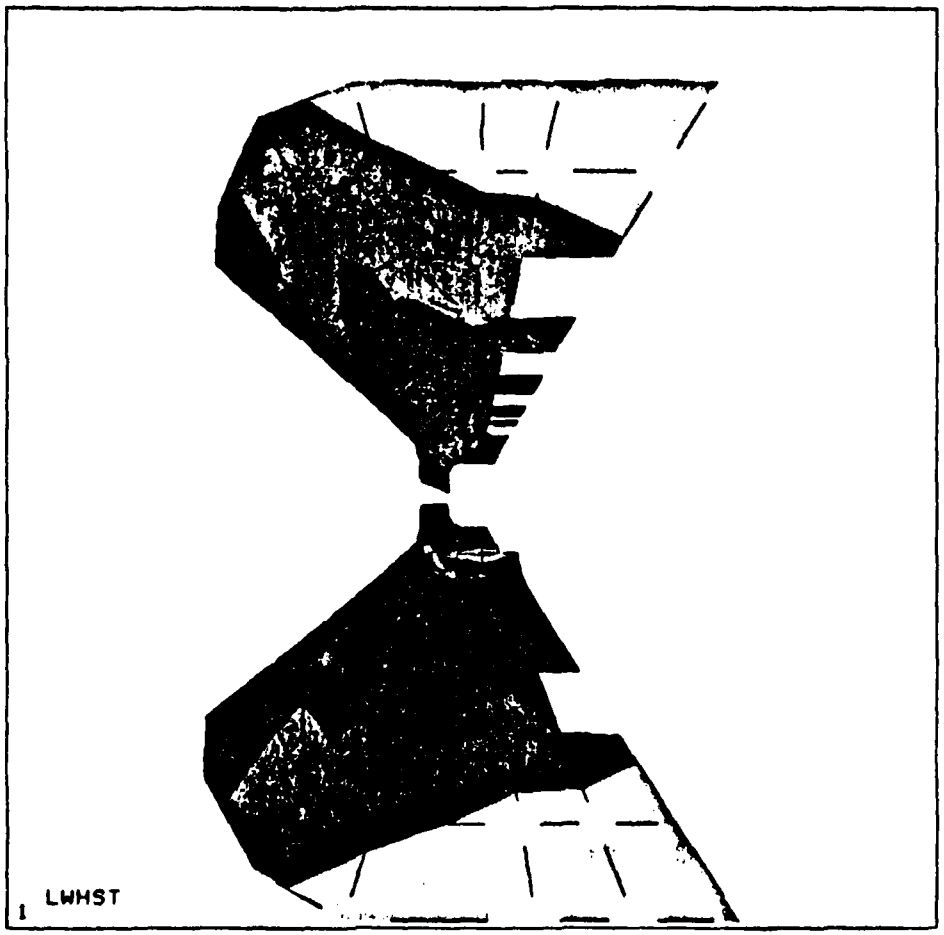
ANSYS 4.2B
FEB 27 1987
3:59:32
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=7900
MN=-16975
-14212
-11448
-8684
-5920
-3156



ANSYS 4.2B
FEB 27 1987
3:59:50
PLOT NO. 2
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

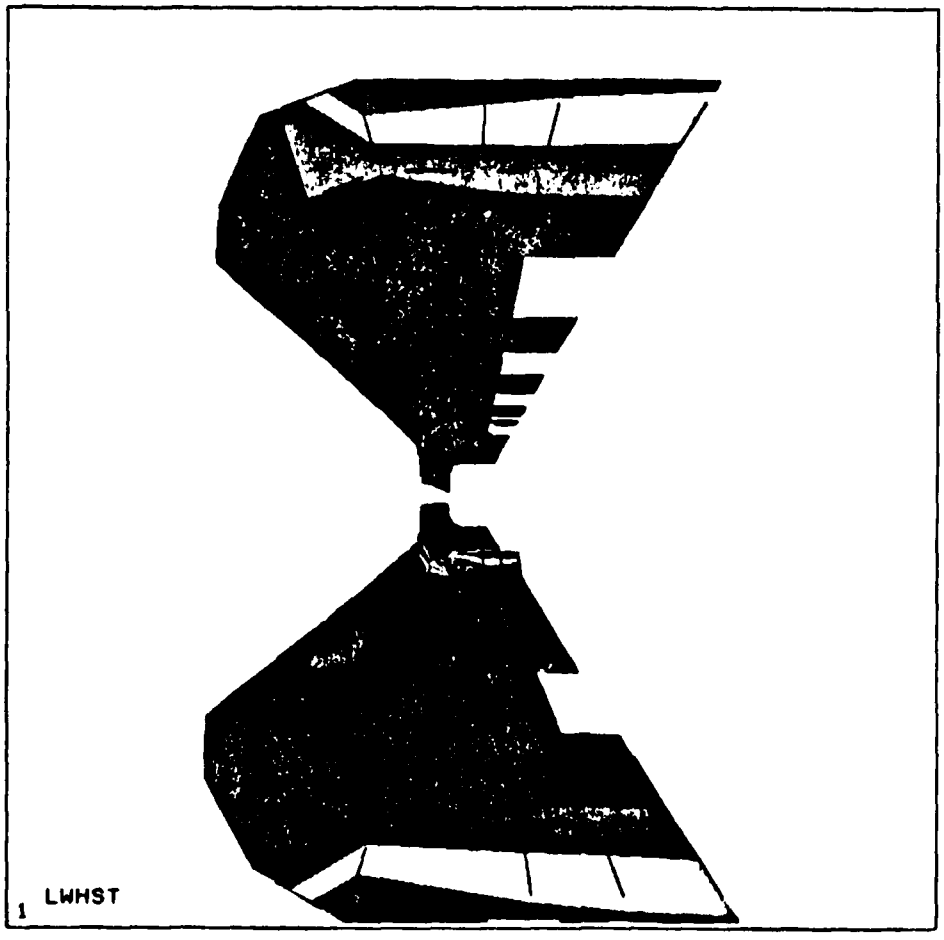
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=5484
MN=-5800
-4547
-3293
-2039
-785
469



ANSYS 4.2B
FEB 27 1987
4:00:07
PLOT NO. 3
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=7900
MN=-16975
-14212
-11448
-8684
-5920
-3156

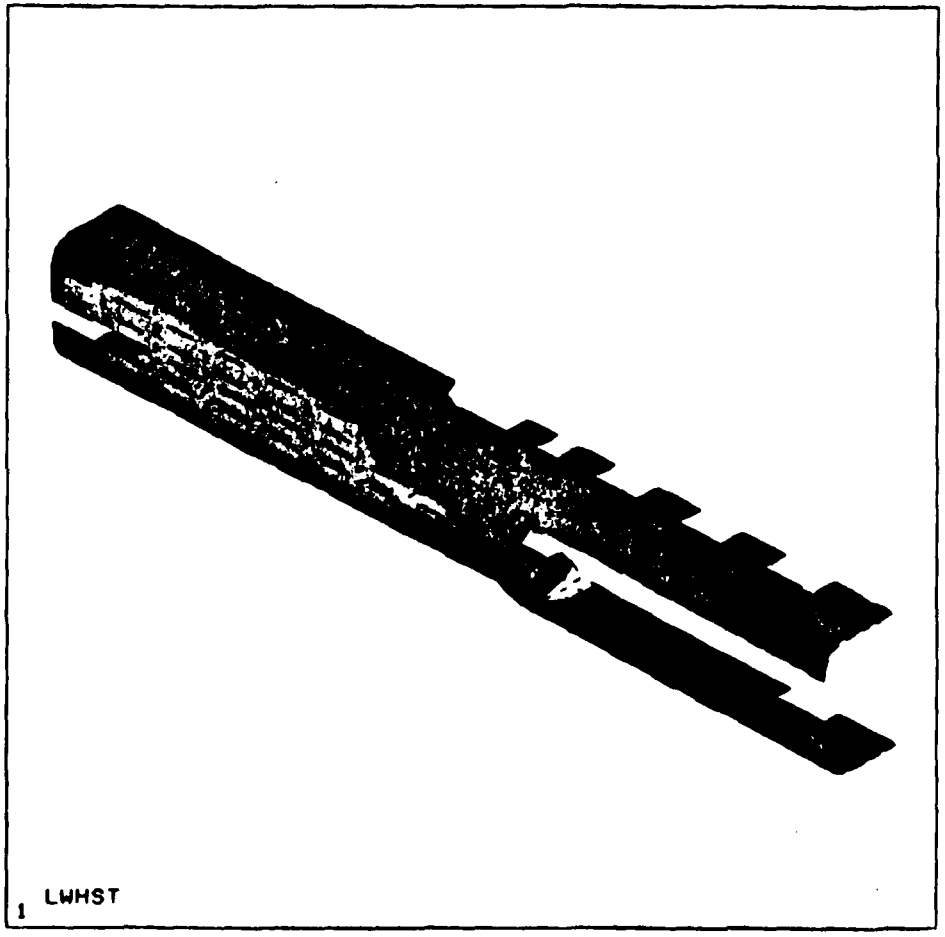
5136
7900



ANSYS 4.2B
FEB 27 1987
4:00:23
PLOT NO. 4
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

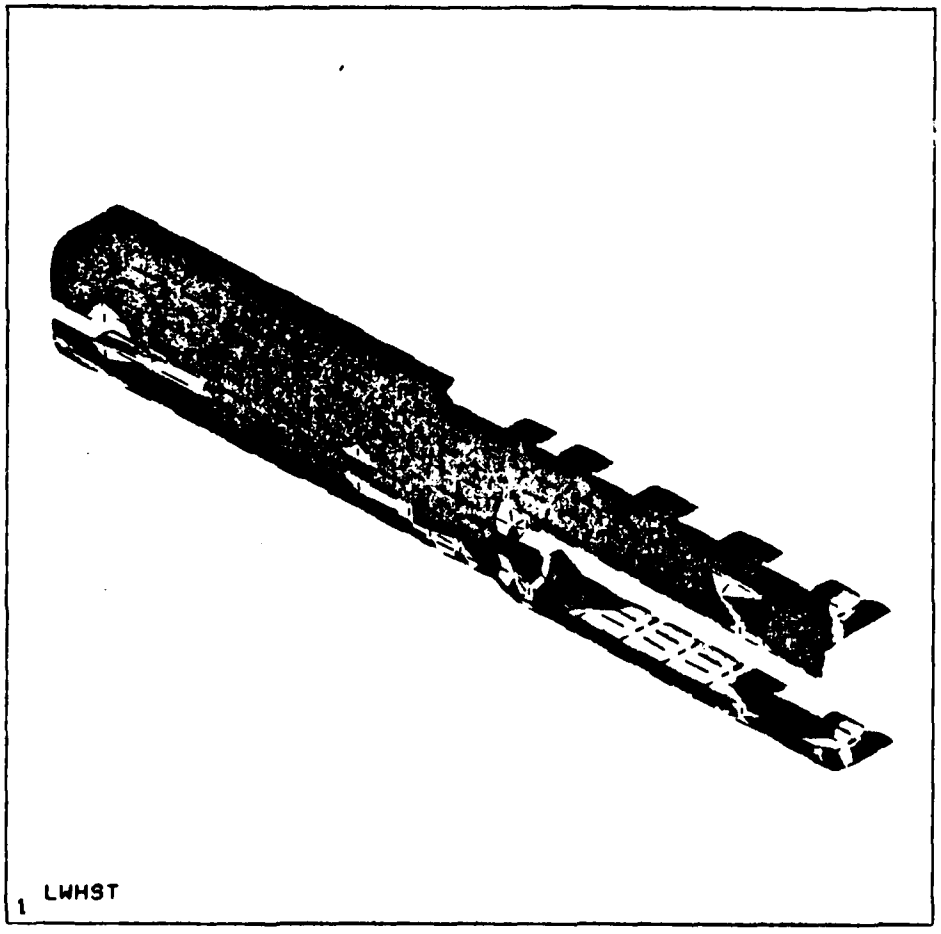
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=5484
MN=-5800
-4547
-3293
-2039
-785
469

4231
5485



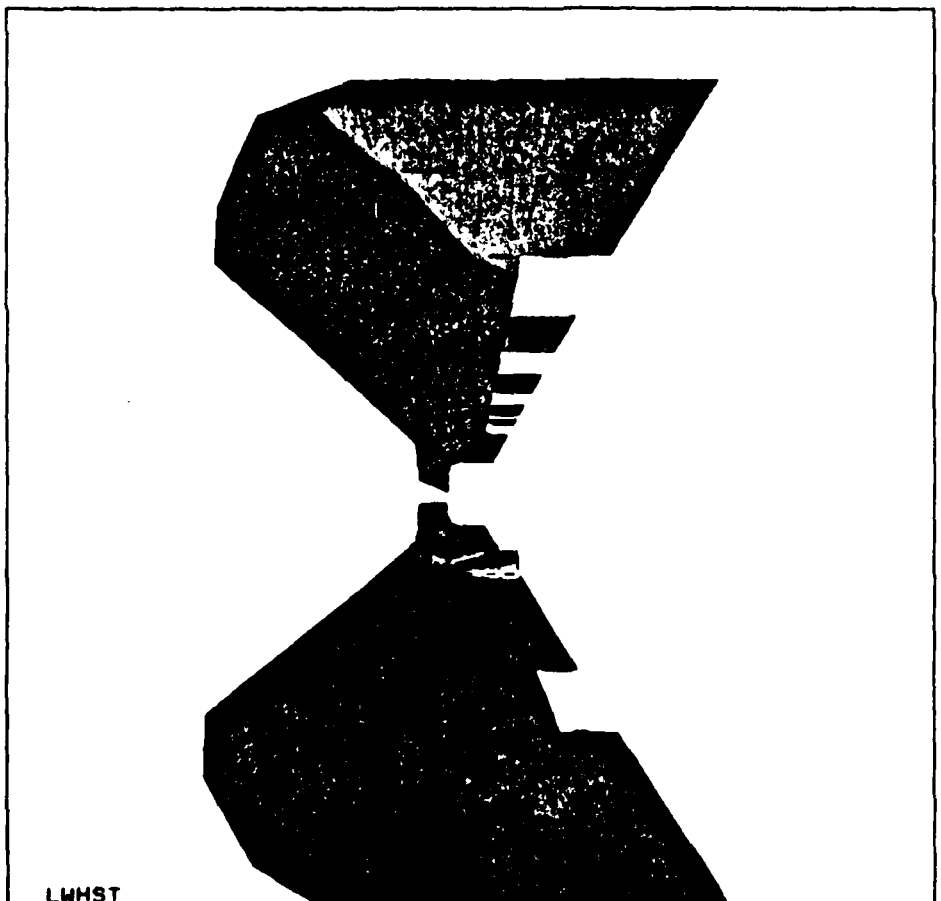
ANSYS 4.2B
FEB 27 1987
4:00:48
PLOT NO. 5
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=12017
MN=-17691
-14391
-11090
-7789
-4488
-1187



ANSYS 4.2B
FEB 27 1987
4:01:04
PLOT NO. 6
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=3773
MN=-6449
-5314
-4178
-3042
-1906
-770



ANSYS 4.2B
FEB 27 1987
4:01:18
PLOT NO. 7
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

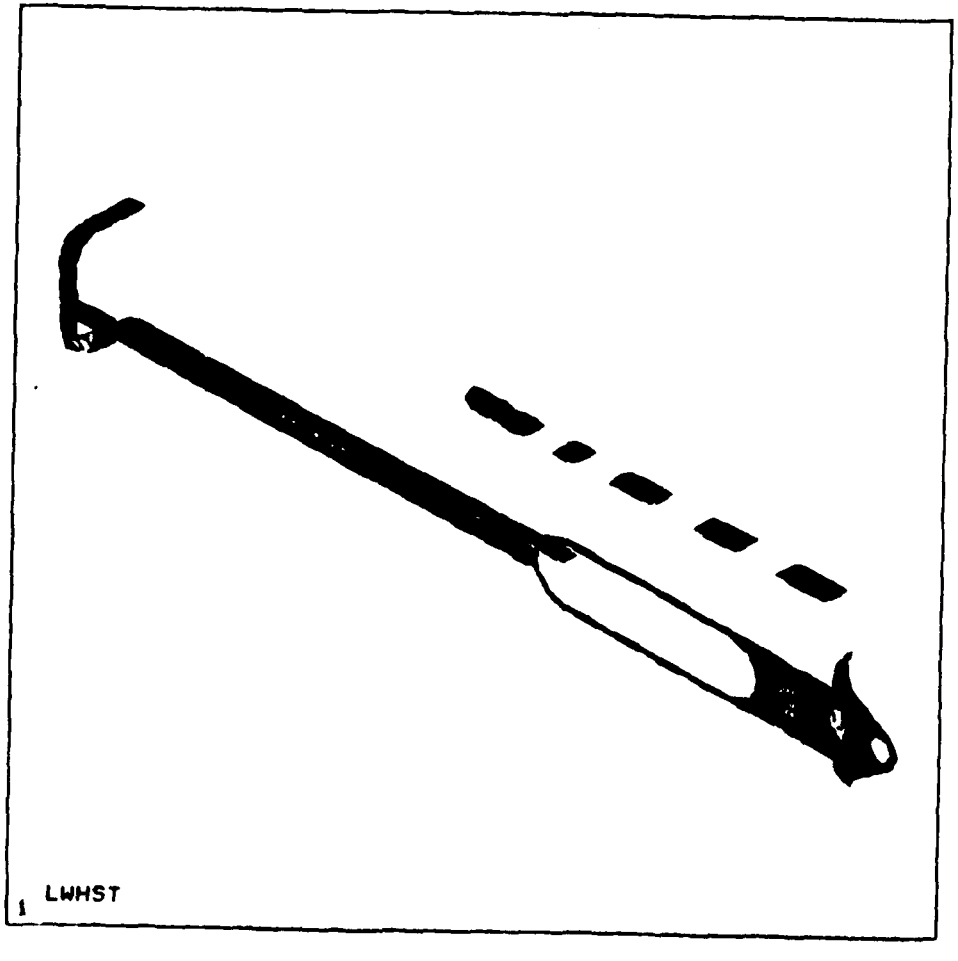
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=12017
MN=-17691
-14391
-11090
-7789
-4488
-1187

8716
12017

ANSYS 4.2B
FEB 27 1987
4:01:34
PLOT NO. 8
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

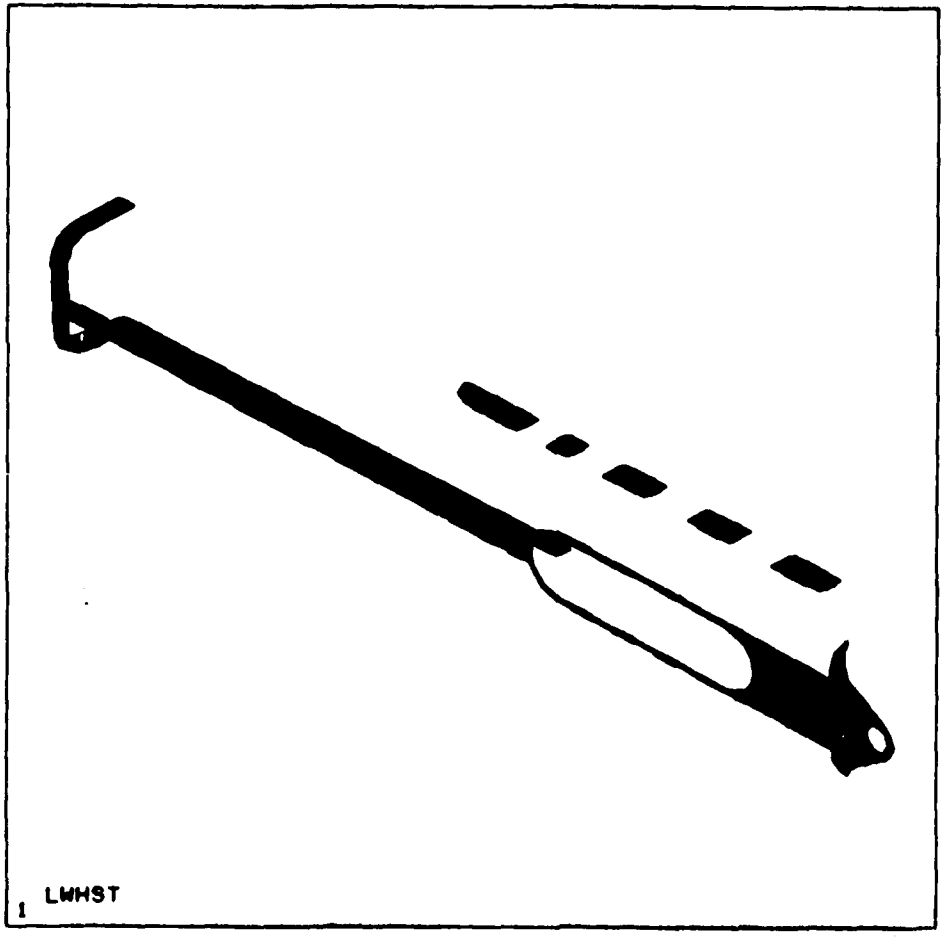
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=3773
MN=-6449
-5314
-4178
-3042
-1906
-770

2638
3774



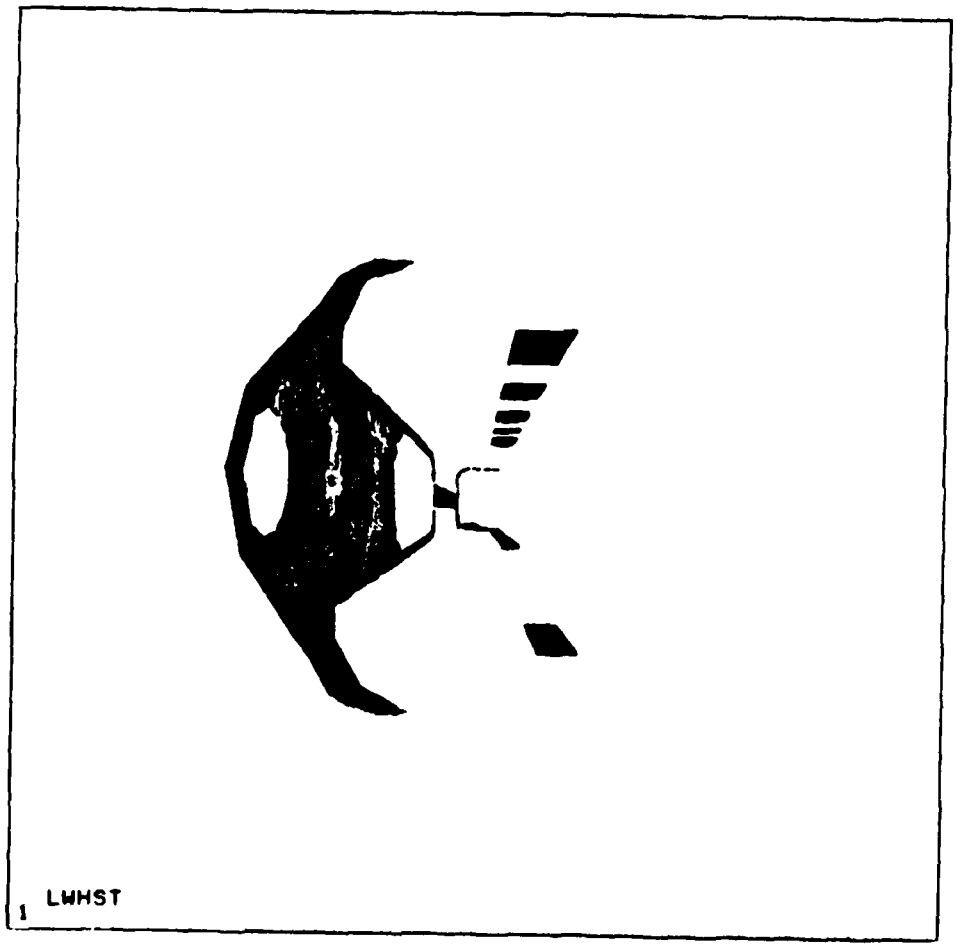
ANSYS 4.2B
FEB 27 1987
4:02:06
PLOT NO. 9
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=40501
MN=-50316
-40226
-30135
-20044
-9953
138



ANSYS 4.2B
FEB 27 1987
4:02:13
PLOT NO. 10
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

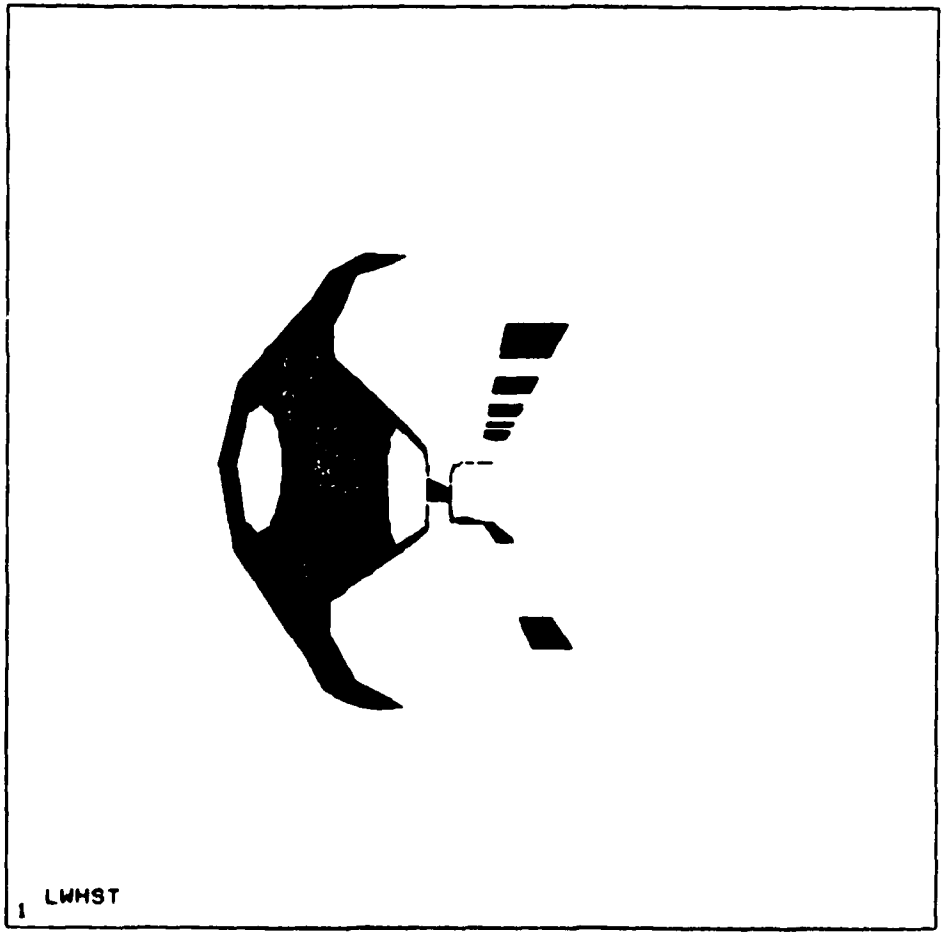
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=55580
MN=-55608
-43256
-30901
-18546
-6191
6164



ANSYS 4.2B
FEB 27 1987
4:02:21
PLOT NO. 11
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

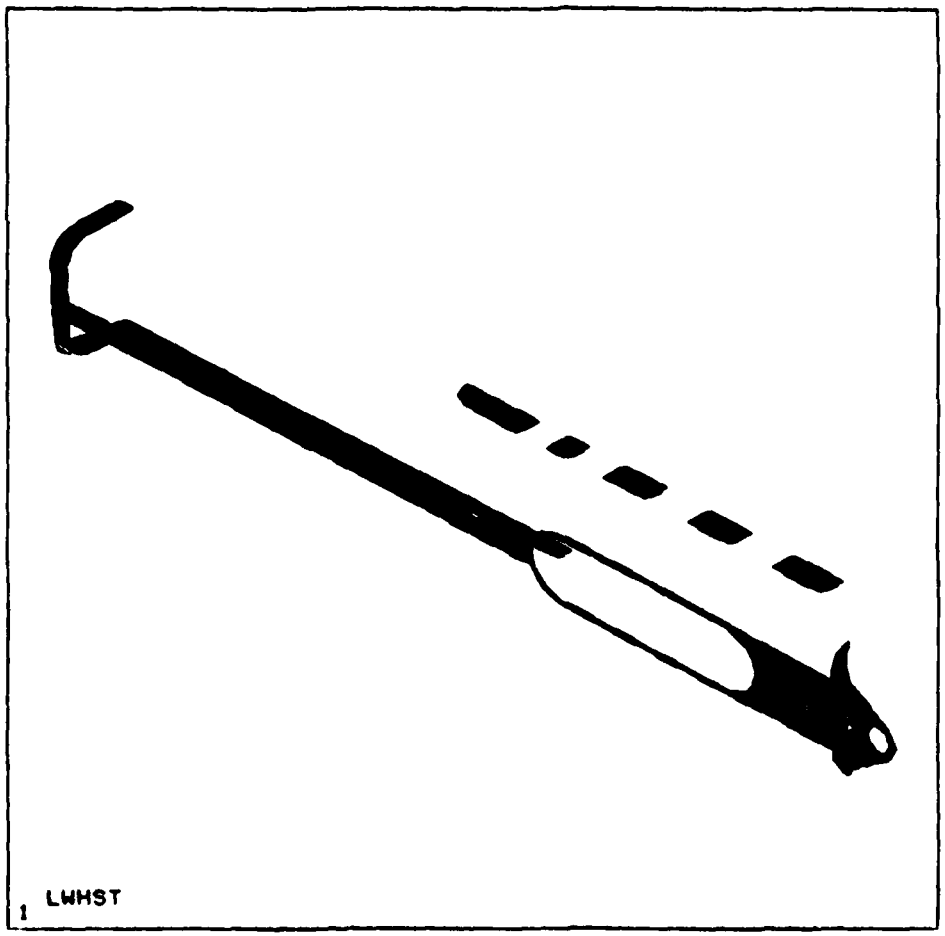
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=40501
MN=-50316
-40226
-30135
-20044
-9953
138

30411
40502



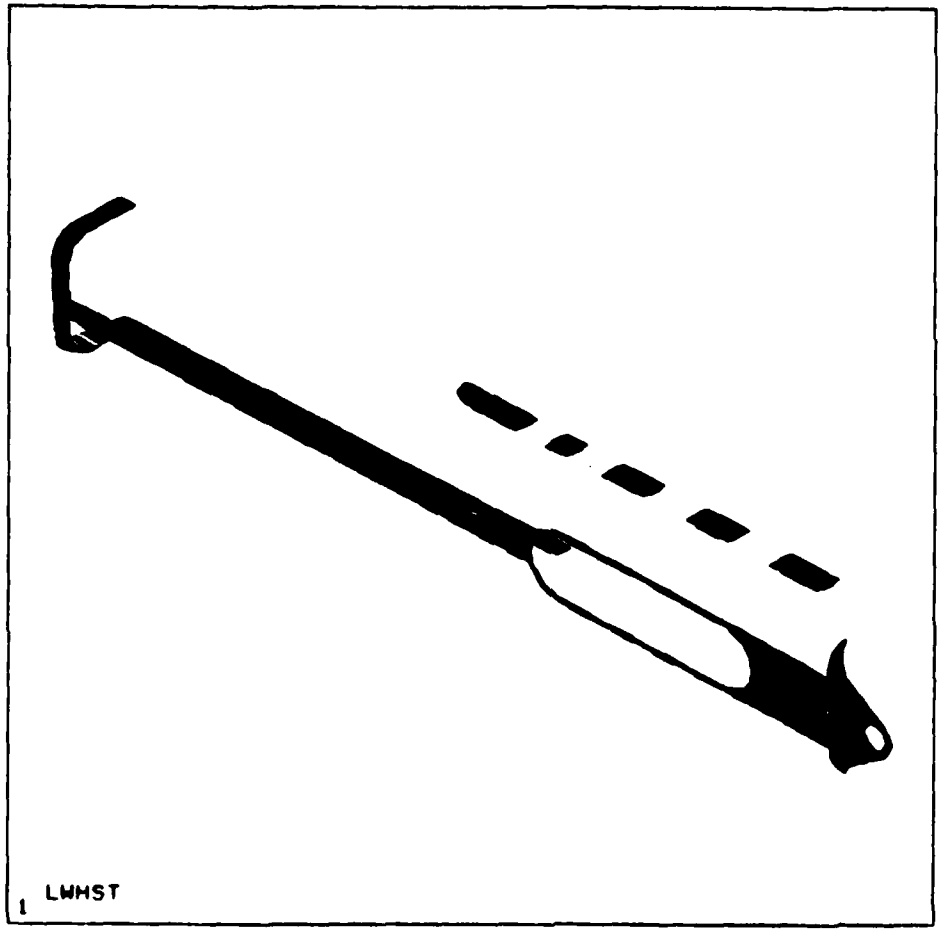
ANSYS 4.2B
FEB 27 1987
4:02:31
PLOT NO. 12
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=55580
MN=-55608
-43256
-30901
-18546
-6191
6164
43229
55584



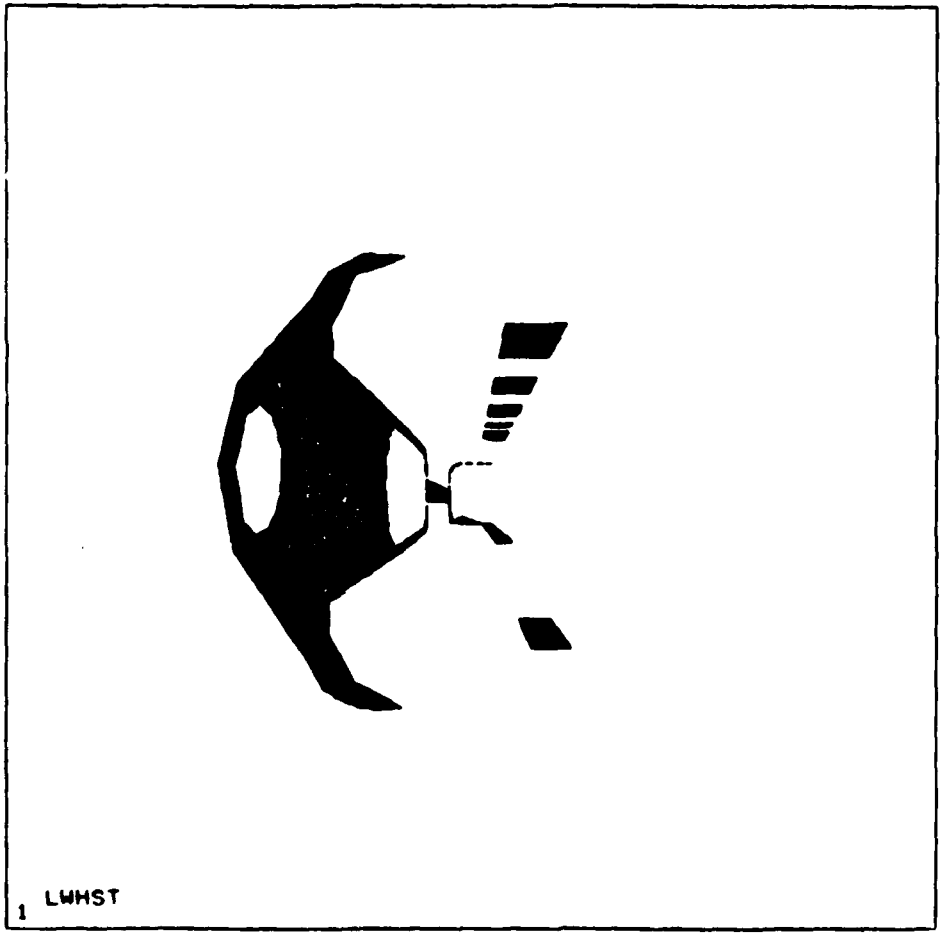
ANSYS 4.2B
FEB 27 1987
4:02:47
PLOT NO. 13
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=28595
MN=-24215
-18348
-12480
-6612
-744
5124



ANSYS 4.2B
FEB 27 1987
4:02:54
PLOT NO. 14
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

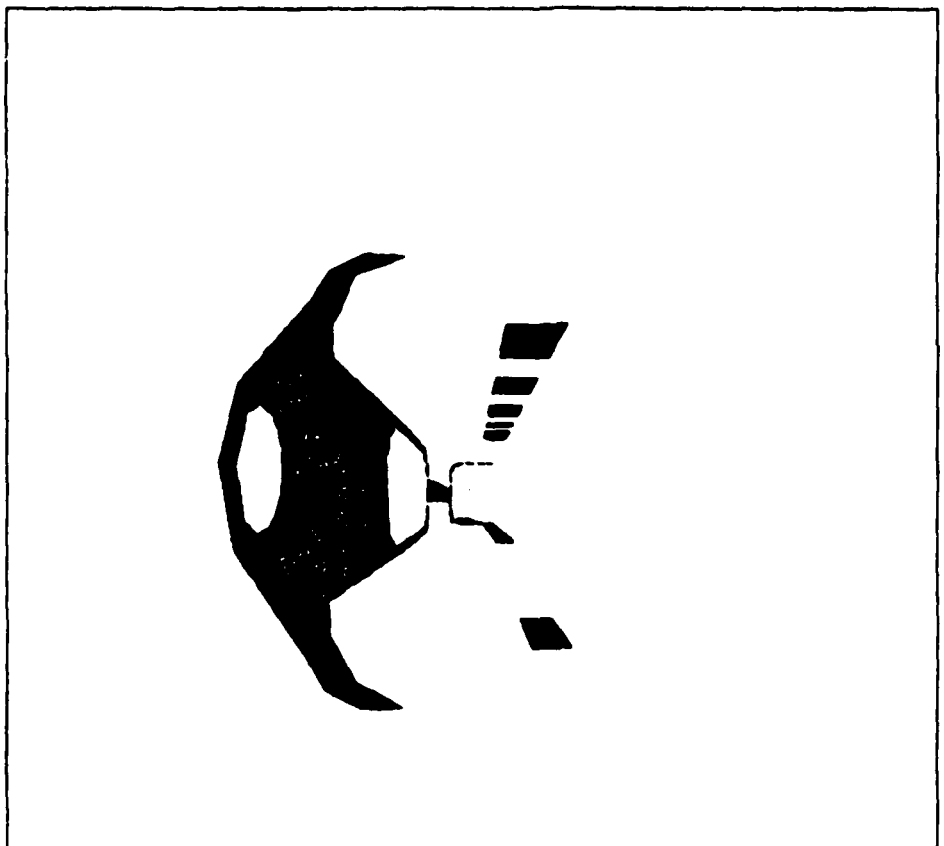
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=34391
MN=-33595
-26045
-18490
-10935
-3380
4175



ANSYS 4.2B
FEB 27 1987
4:03:03
PLOT NO. 15
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=28595
MN=-24215
-18348
-12480
-6612
-744
5124

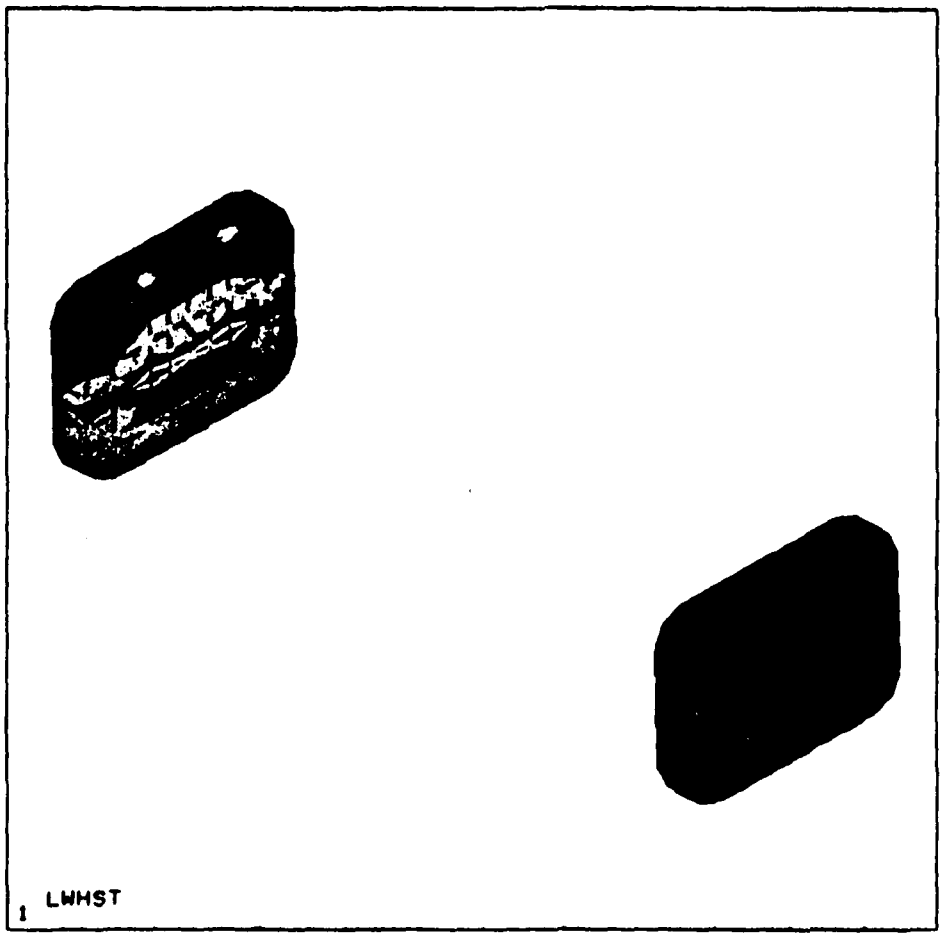
22728
28596



ANSYS 4.2B
FEB 27 1987
4:03:12
PLOT NO. 16
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

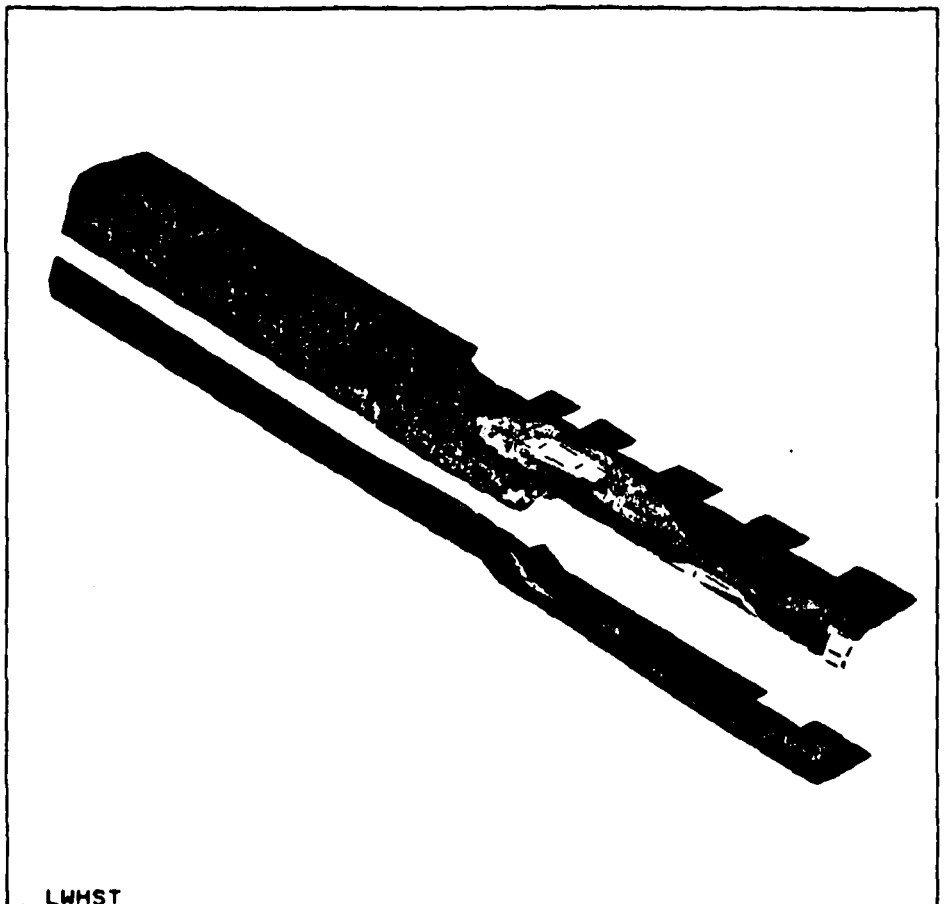
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=34391
MN=-33595
-26045
-18490
-10935
-3380
4175

26840
34395



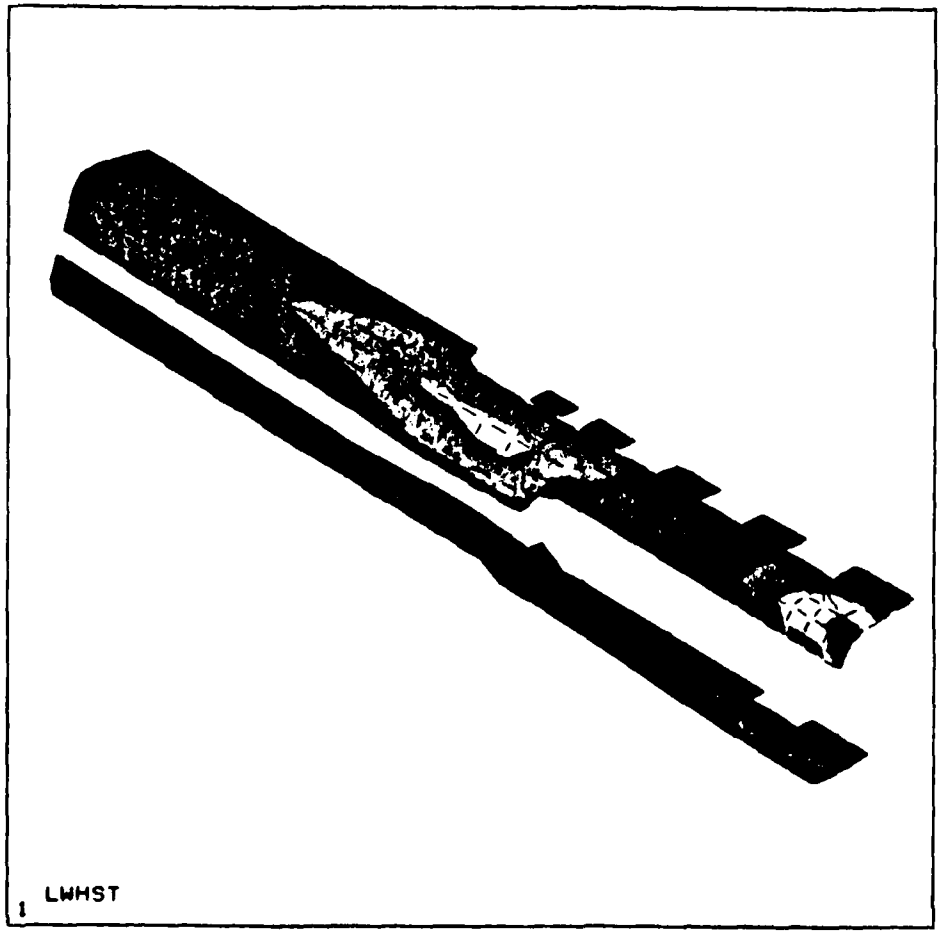
ANSYS 4.2B
FEB 27 1987
4:03:34
PLOT NO. 17
POST1 STRESS
STEP=1
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2464
MN=4.41
275
549
823
1097
1371
[illegible]
[illegible]
2193
2467



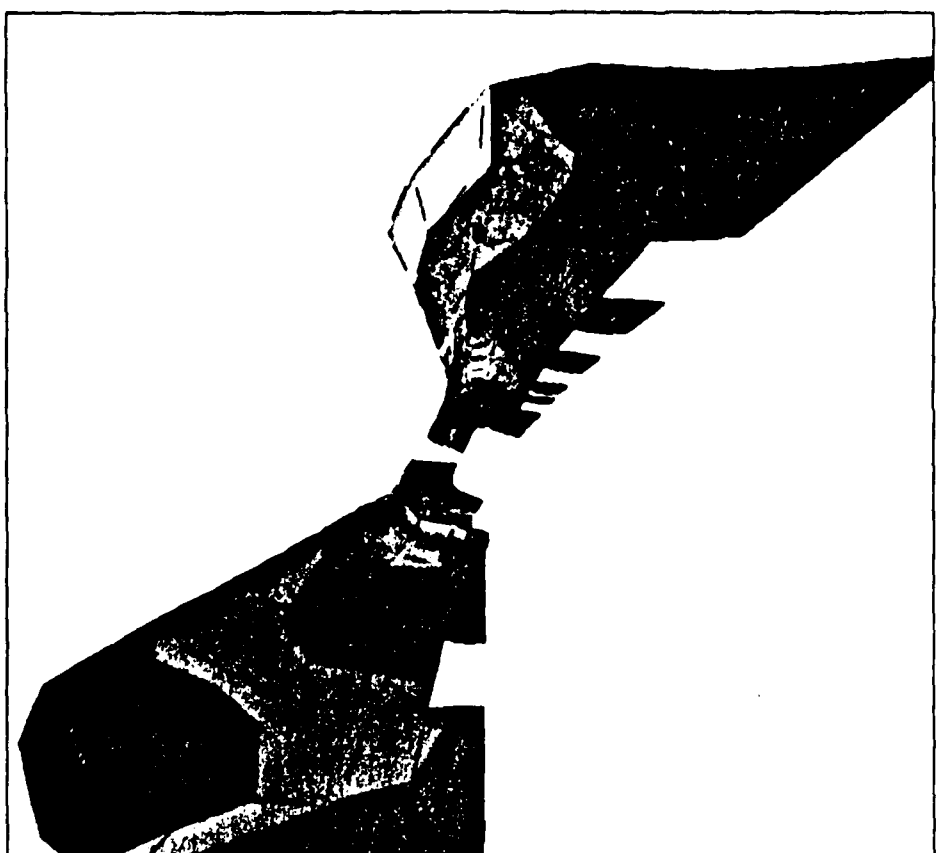
ANSYS 4.2B
FEB 27 1987
4:05:04
PLOT NO. 18
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=11589
MN=-6562
-4546
-2529
-512
1505
3522



ANSYS 4.2B
FEB 27 1987
4:05:23
PLOT NO. 19
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

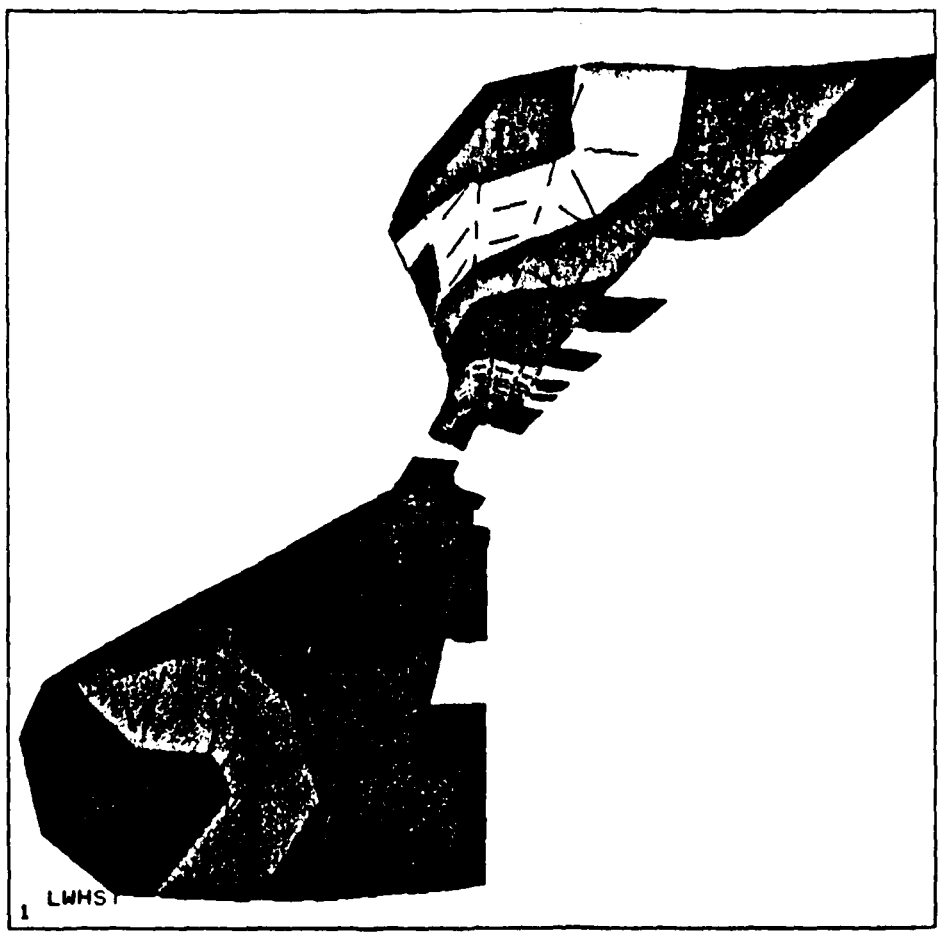
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=18058
MN=-17974
-13972
-9968
-5964
-1960
2044



ANSYS 4.2B
FEB 27 1987
4:05:38
PLOT NO. 20
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=11589
MN=-6562
-4546
-2529
-512
1505
3522

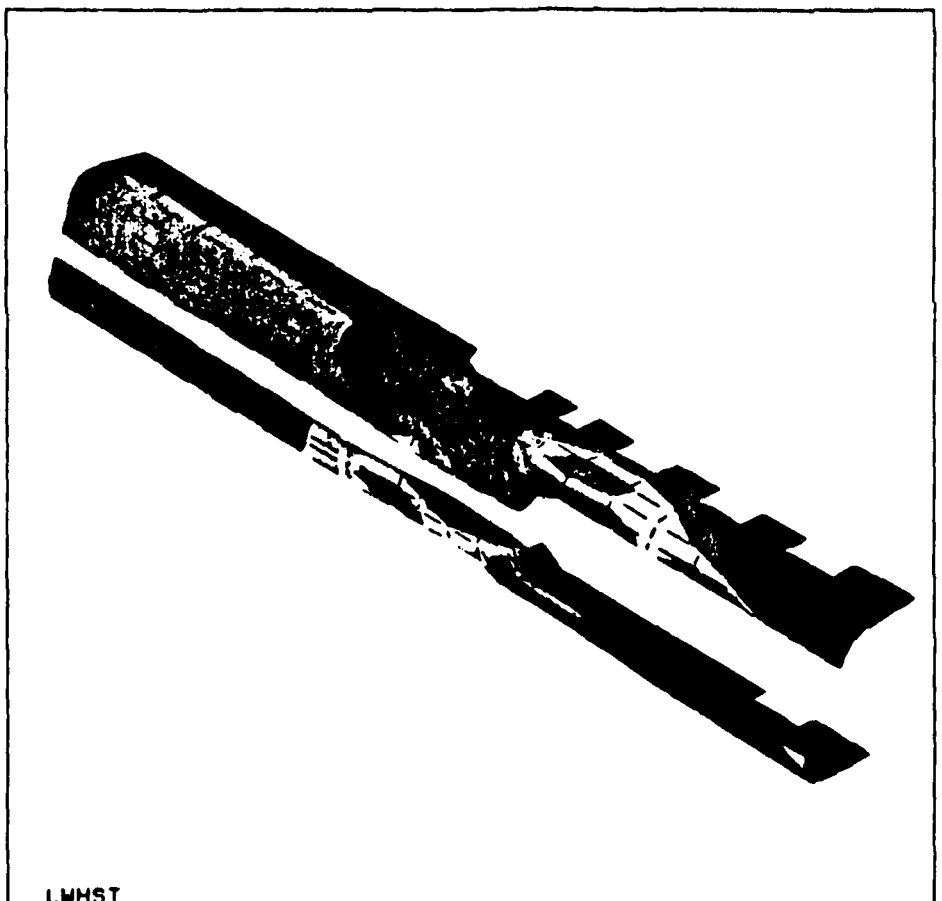
9573
11590



ANSYS 4.2B
FEB 27 1987
4:05:56
PLOT NO. 21
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

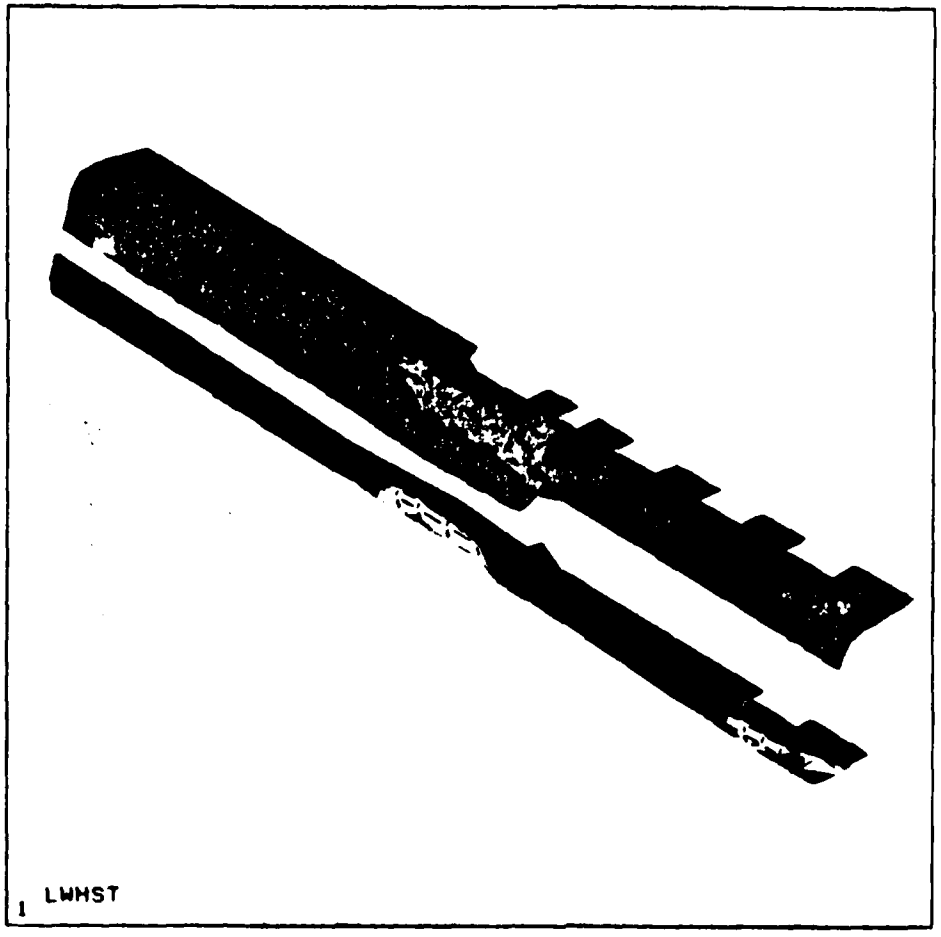
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=18058
MN=-17974
-13972
-9968
-5964
-1960
2044

14056
18060



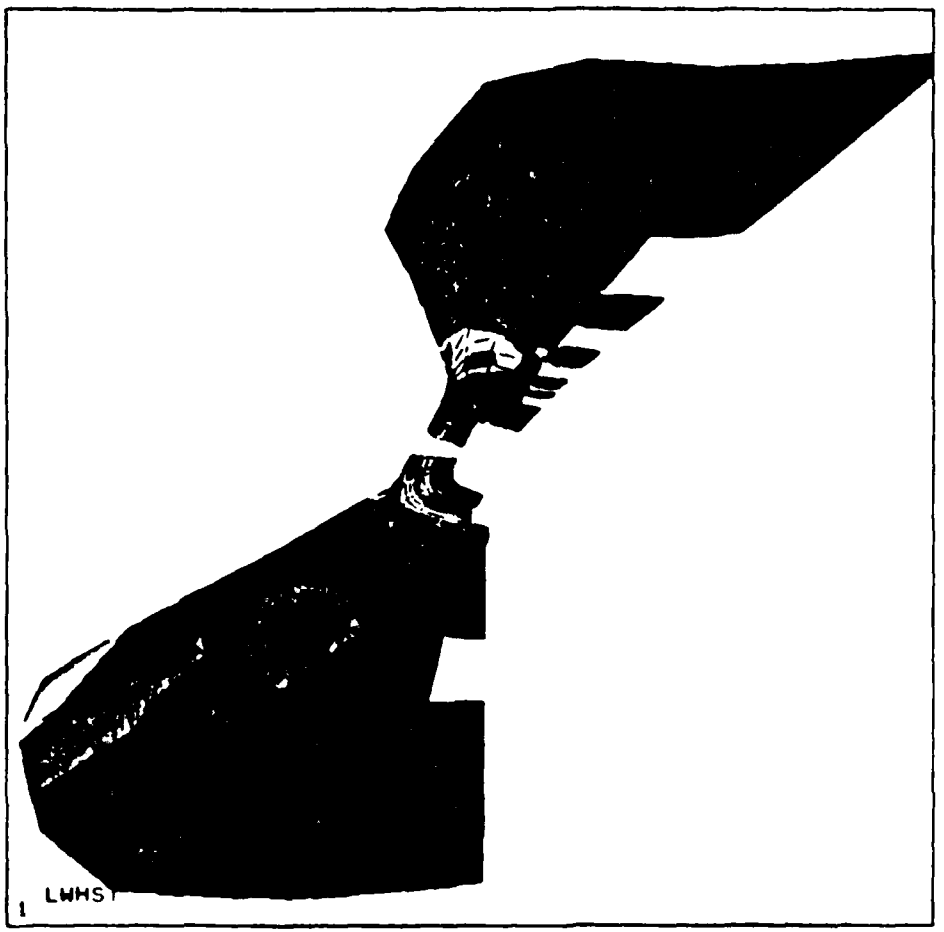
ANSYS 4.2B
FEB 27 1987
4:06:20
PLOT NO. 22
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=8566
MN=-7171
-5424
-3675
-1926
-177
1572



ANSYS 4.2B
FEB 27 1987
4:06:37
PLOT NO. 23
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=13503
MN=-13296
-10320
-7342
-4364
-1386
1592



ANSYS 4.2B
FEB 27 1987
4:06:52
PLOT NO. 24
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

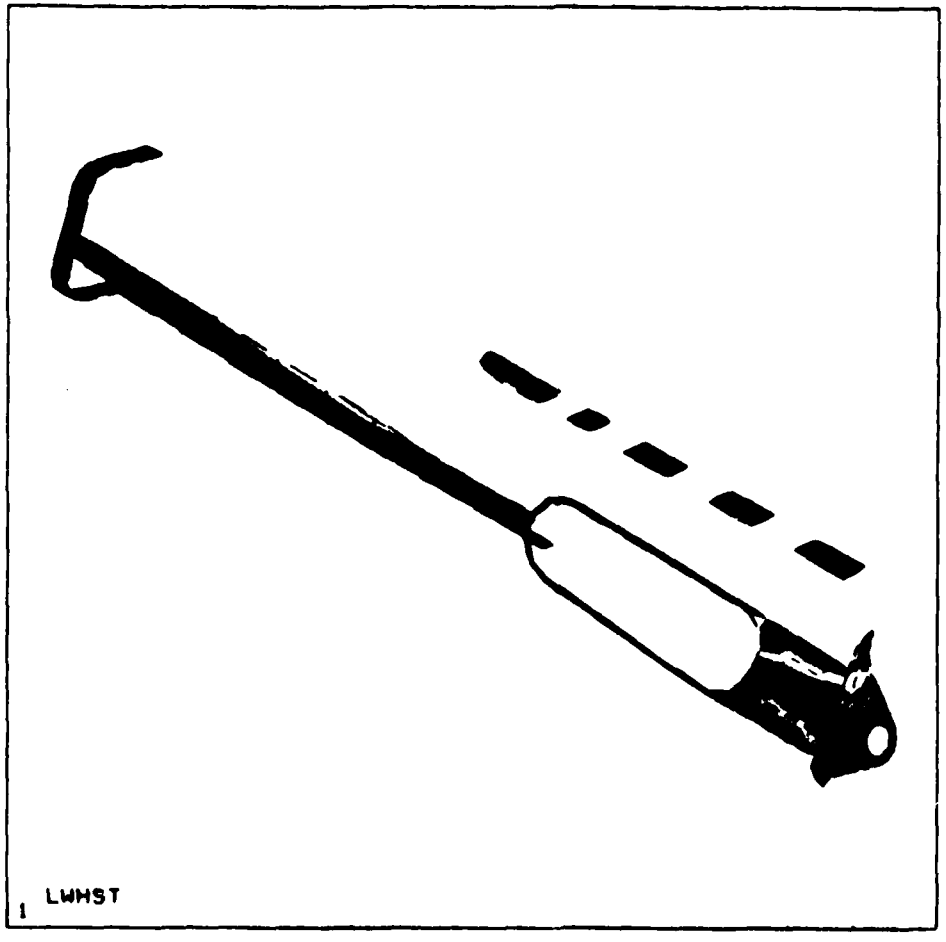
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=8566
MN=-7171
-5424
-3675
-1926
-177
1572

6819
8568

ANSYS 4.2B
FEB 27 1987
4:07:07
PLOT NO. 25
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

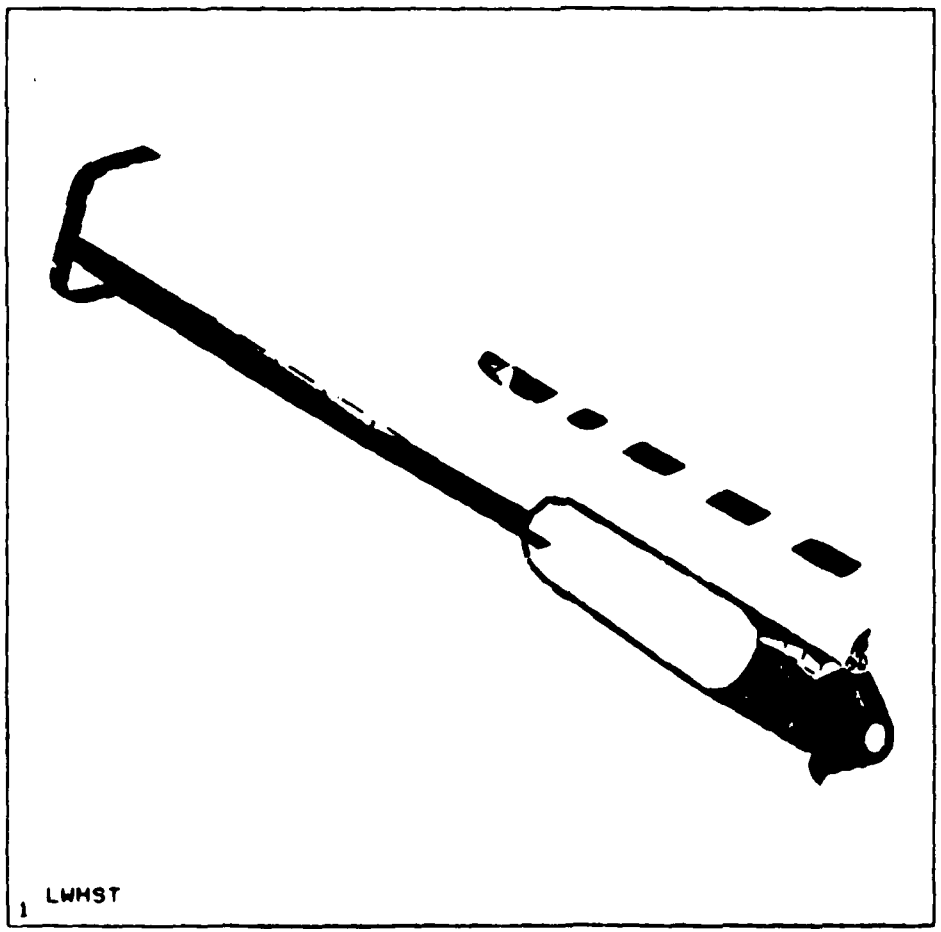
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=13503
MN=-13296
-10320
-7342
-4364
-1386
1592

10526
13504



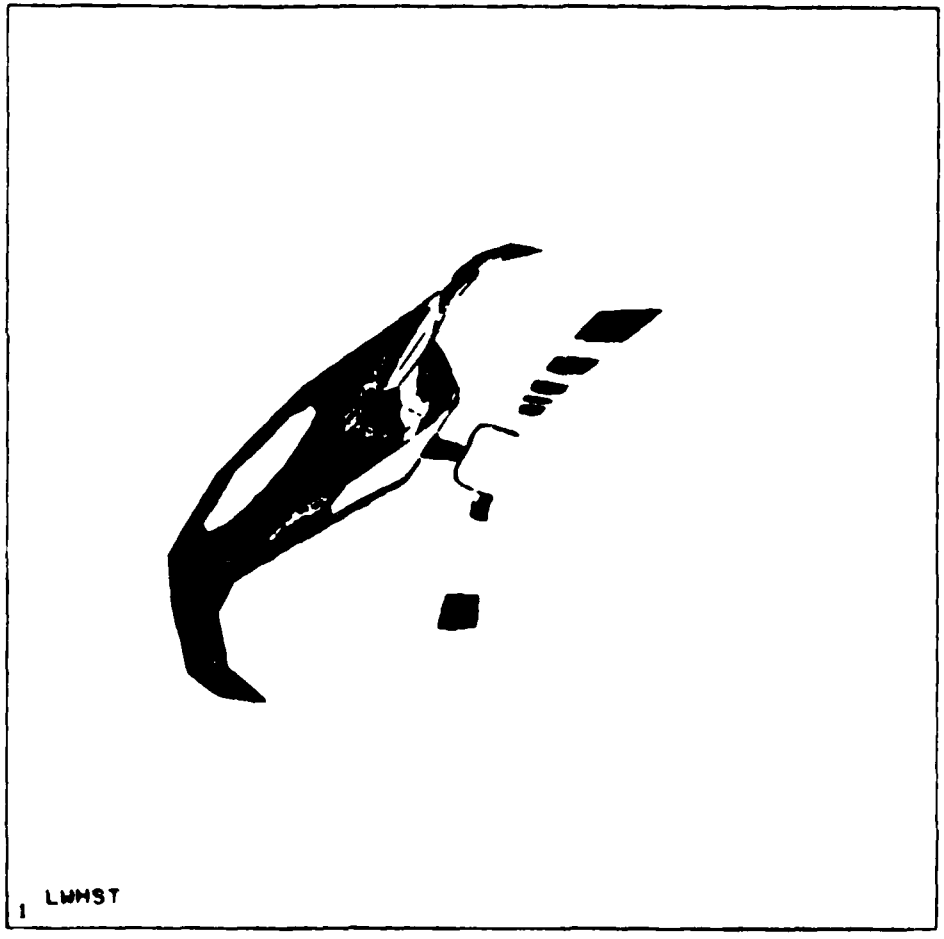
ANSYS 4.2B
FEB 27 1987
4:07:39
PLOT NO. 26
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=22509
MN=-22468
-17472
-12474
-7476
-2478
2520



ANSYS 4.2B
FEB 27 1987
4:07:47
PLOT NO. 27
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

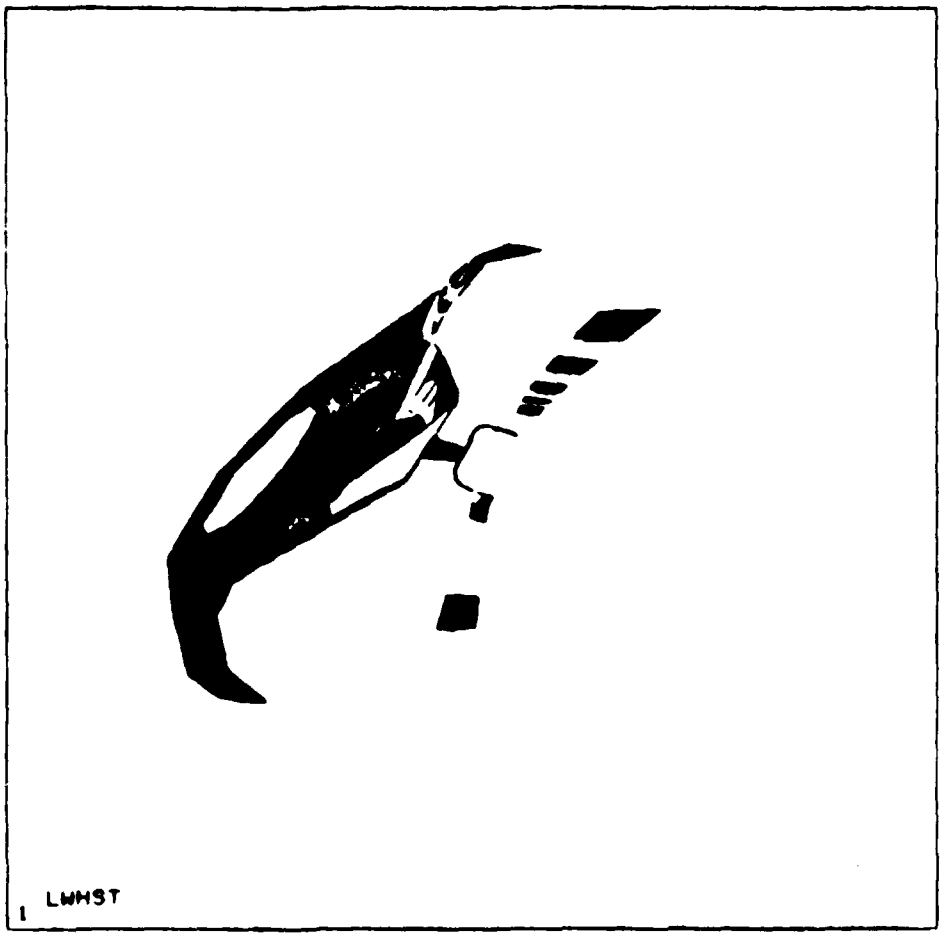
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=14090
MN=-13787
-10691
-7593
-4495
-1397
1701



ANSYS 4.2B
FEB 27 1987
4:07:57
PLOT NO. 28
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=22509
MN=-22468
-17472
-12474
-7476
-2478
2520

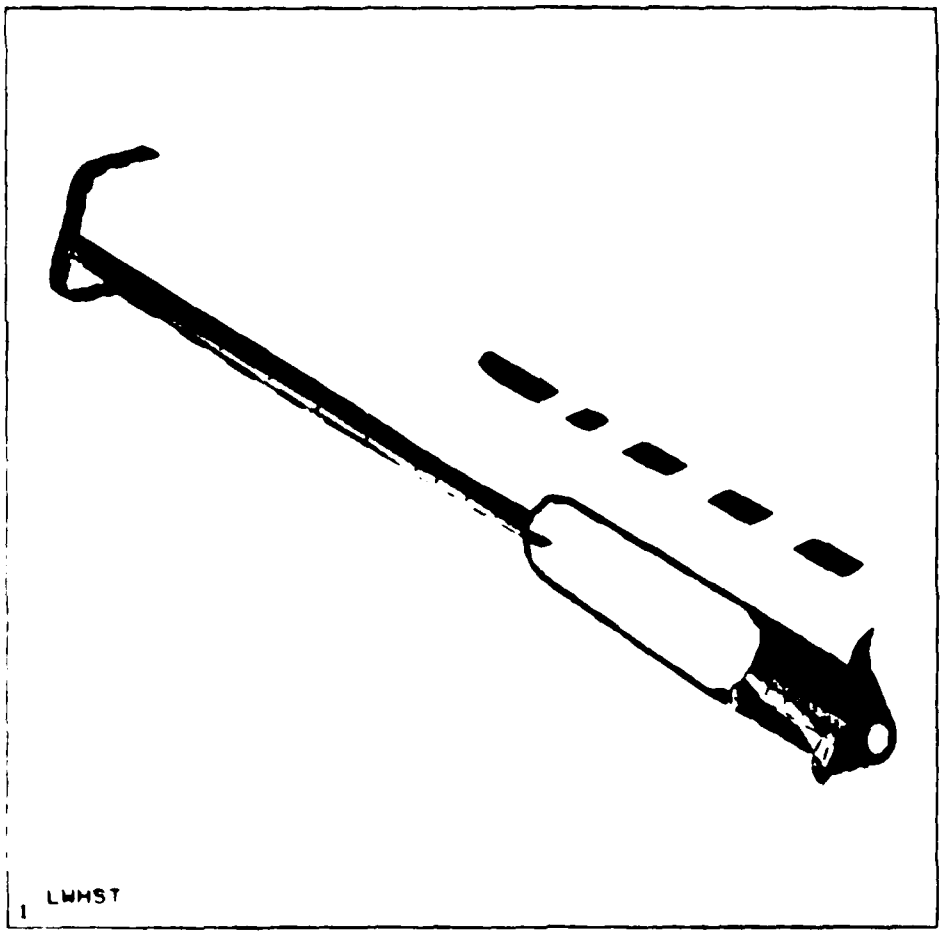
17514
22512



ANSYS 4.2B
FEB 27 1987
4:08:04
PLOT NO. 29
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

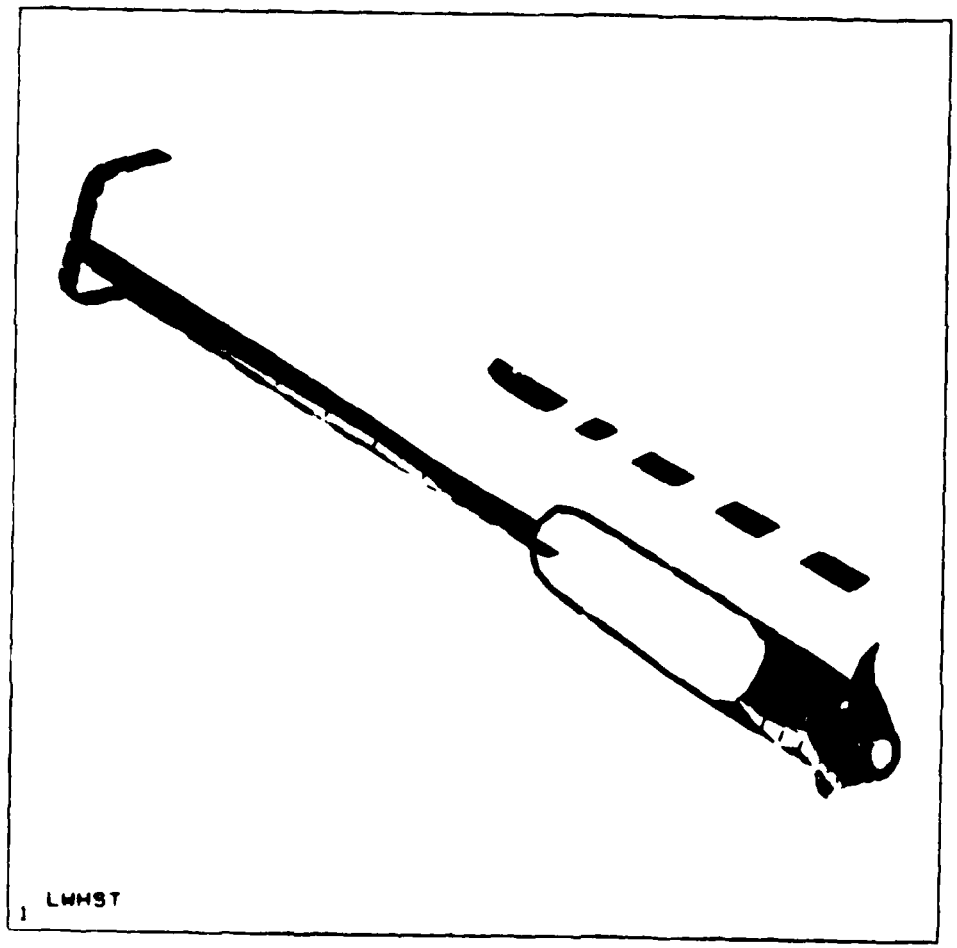
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=14090
MN=-13787
-10691
-7593
-4495
-1397
1701

10995
14093



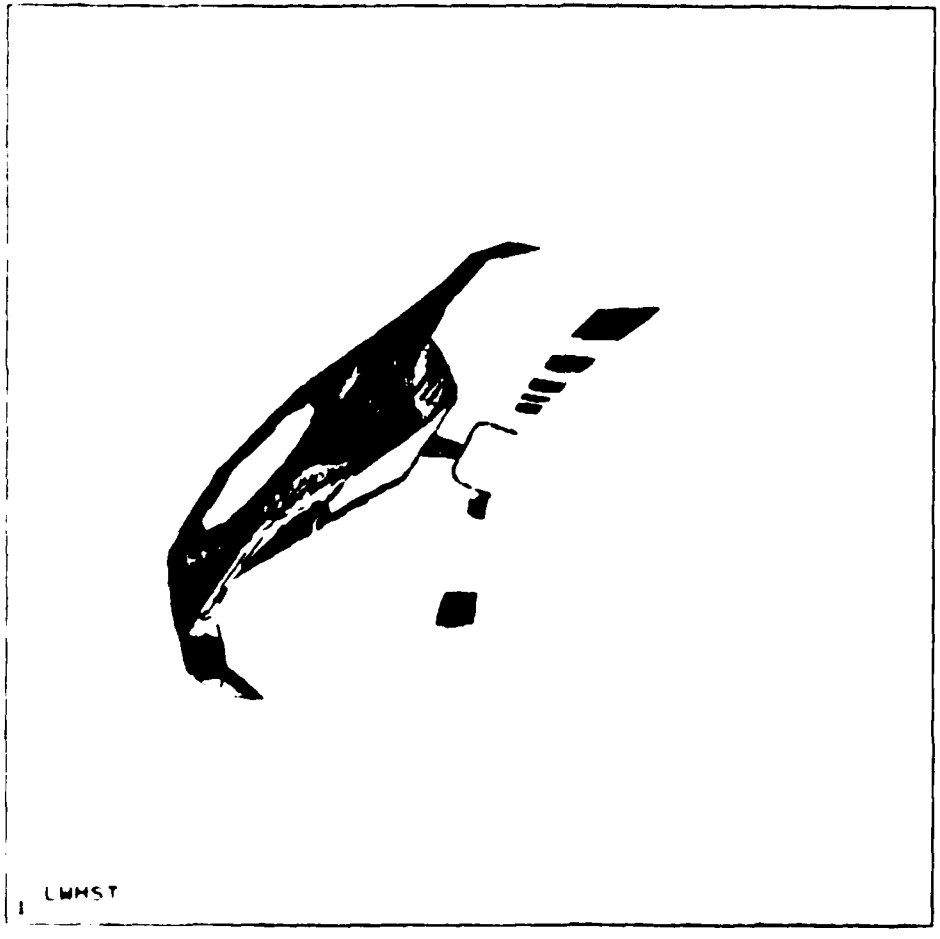
ANSYS 4.2B
FEB 27 1987
4:08:21
PLOT NO. 30
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=22876
MN=-27937
-22291
-16645
-10999
-5353
293



ANSYS 4.2B
FEB 27 1987
4:08:30
PLOT NO. 31
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

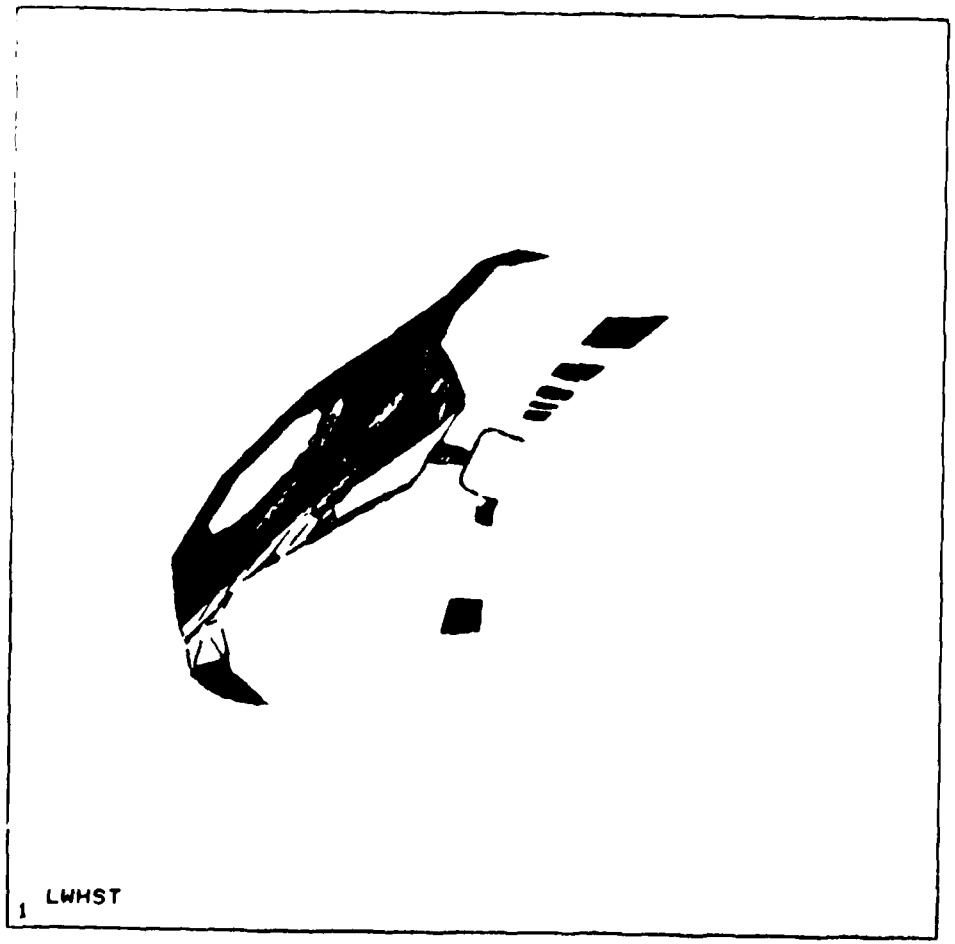
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
MIDDEN
MX=12131
MN=-11644
-9004
-6362
-3720
-1078
1564



ANSYS 4.2B
FEB 27 1987
4:08:40
PLOT NO. 32
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=22876
MN=-27937
-22291
-16645
-10999
-5353
293

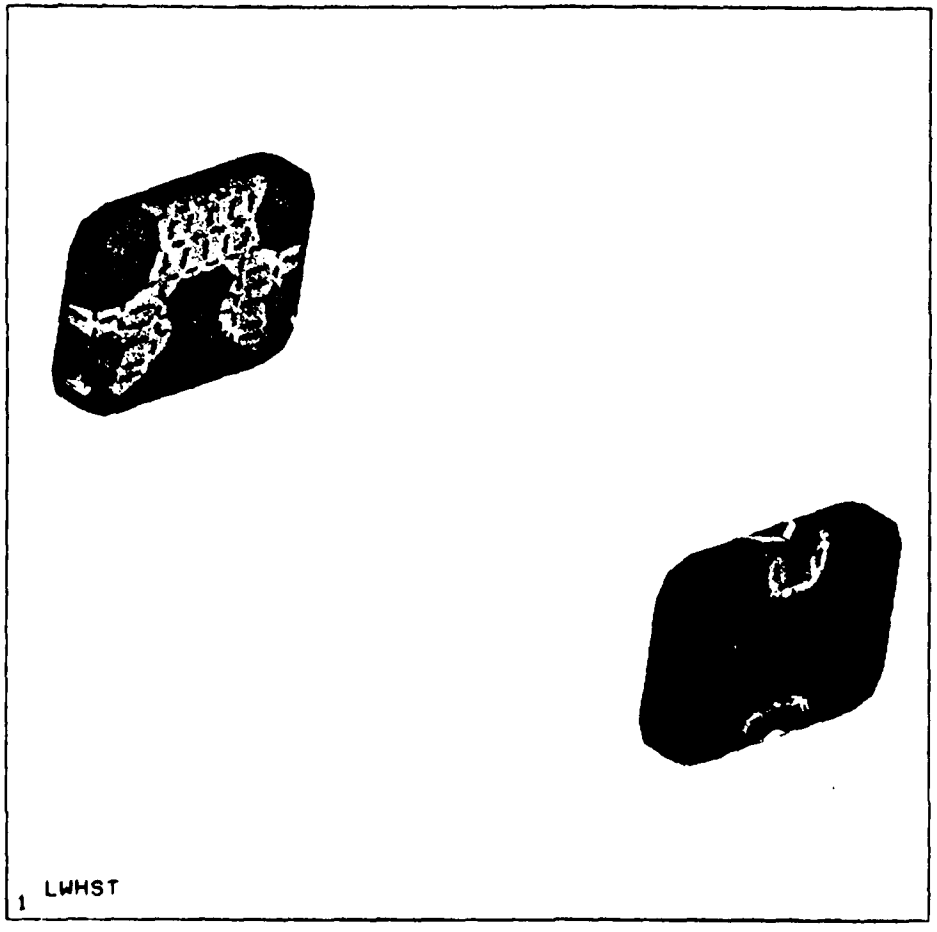
17231
22877



ANSYS 4.2B
FEB 27 1987
4:08:48
PLOT NO. 33
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=12131
MN=-11644
-9004
-6362
-3720
-1078
1564

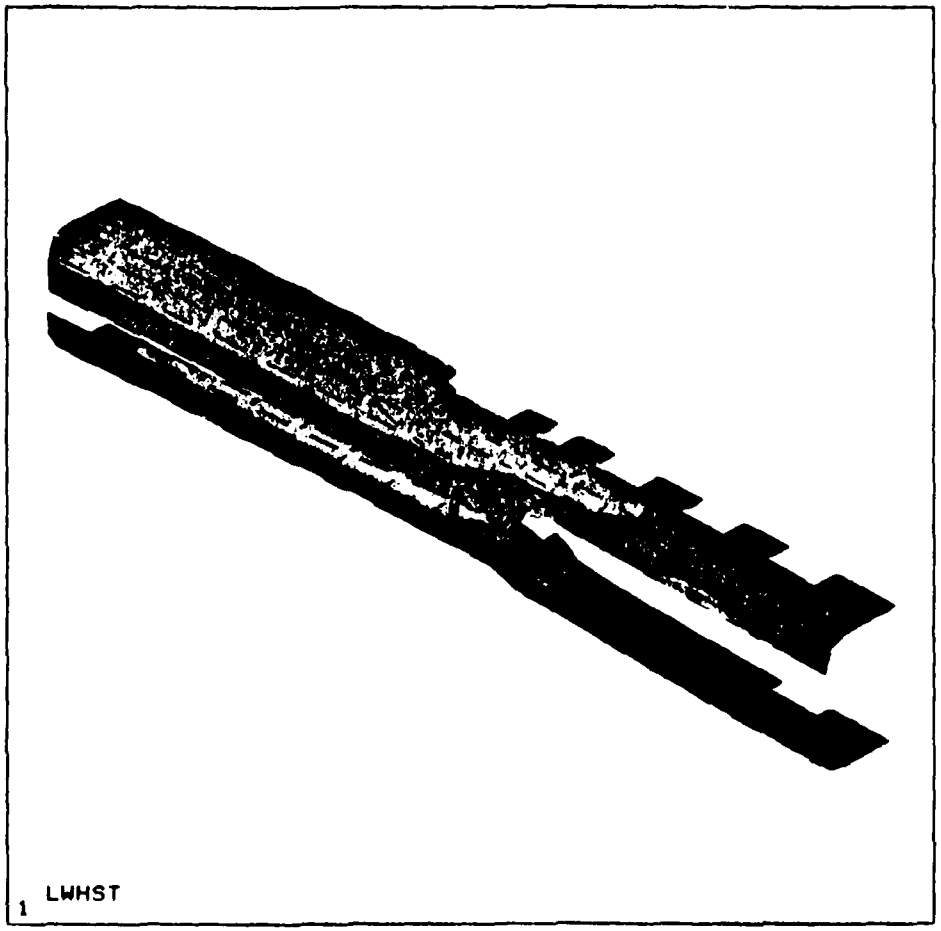
9490
12132



ANSYS 4.2B
FEB 27 1987
4:09:10
PLOT NO. 34
POST1 STRESS
STEP=2
ITER=1
SIGE
BOTTOM

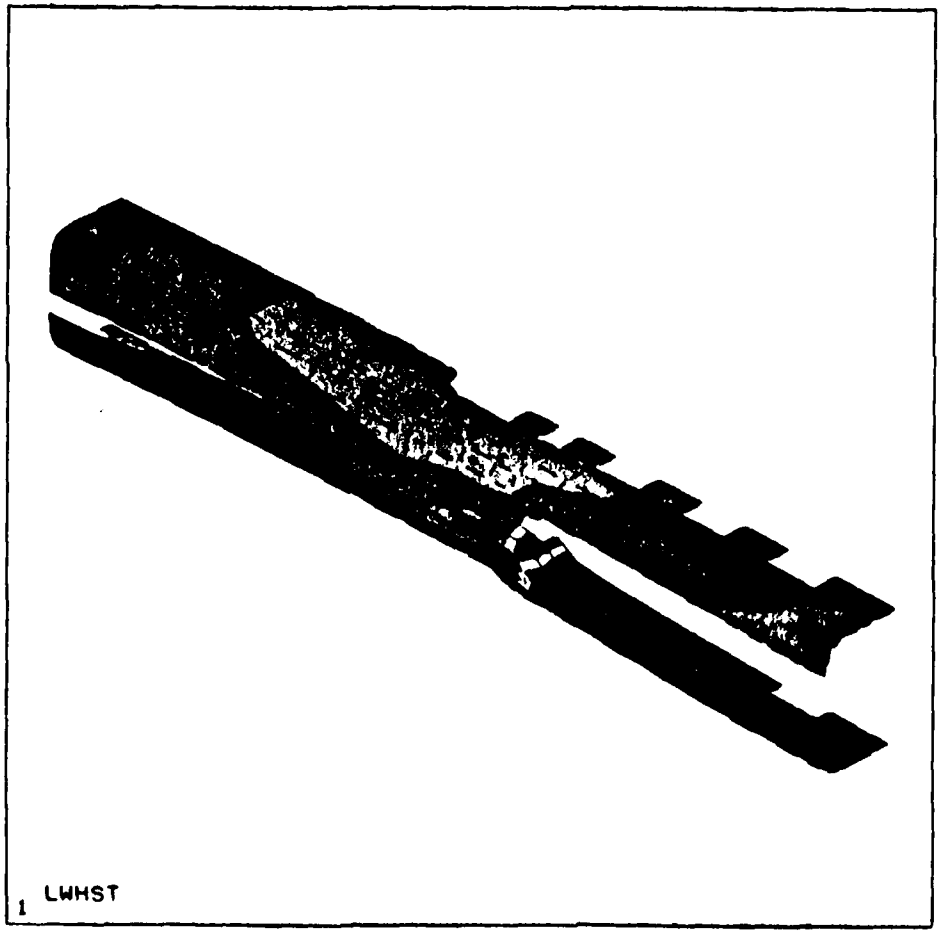
XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=1147
MN=18.8
142
268
394
520
646

1024
1150



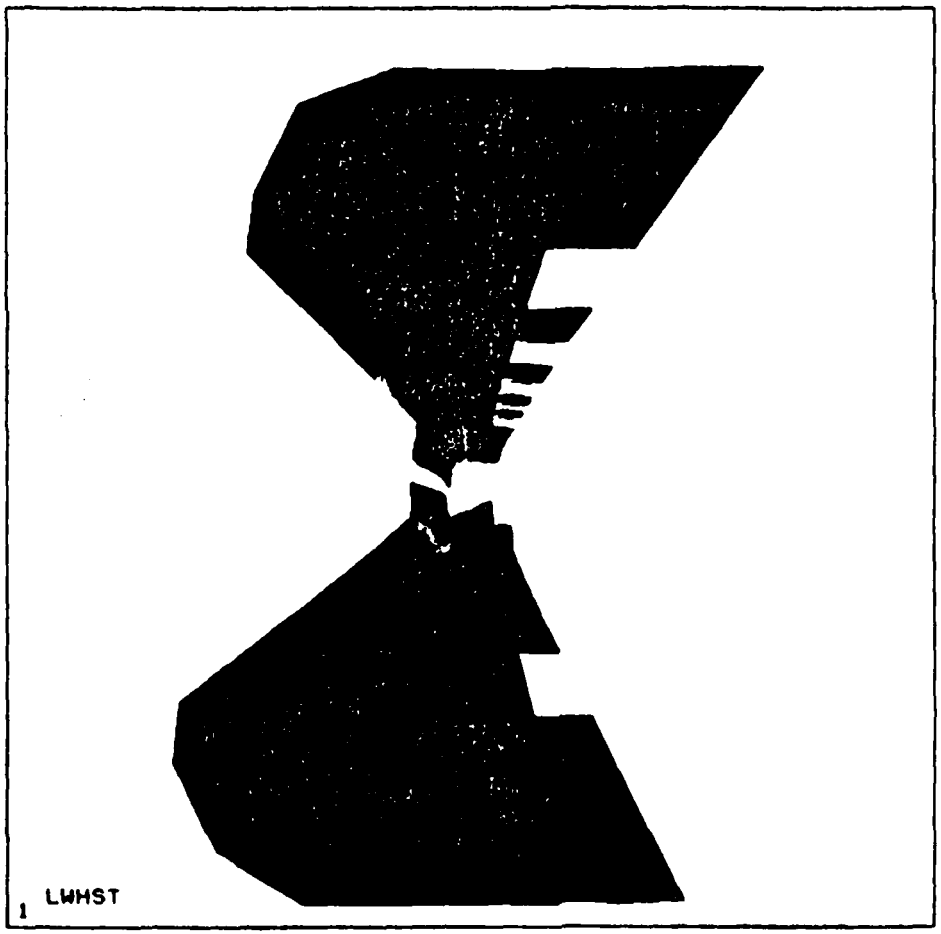
ANSYS 4.2B
FEB 27 1987
4:10:44
PLOT NO. 35
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=9475
MN=-9150
-7082
-5012
-2942
-872
1198



ANSYS 4.2B
FEB 27 1987
4:11:02
PLOT NO. 36
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

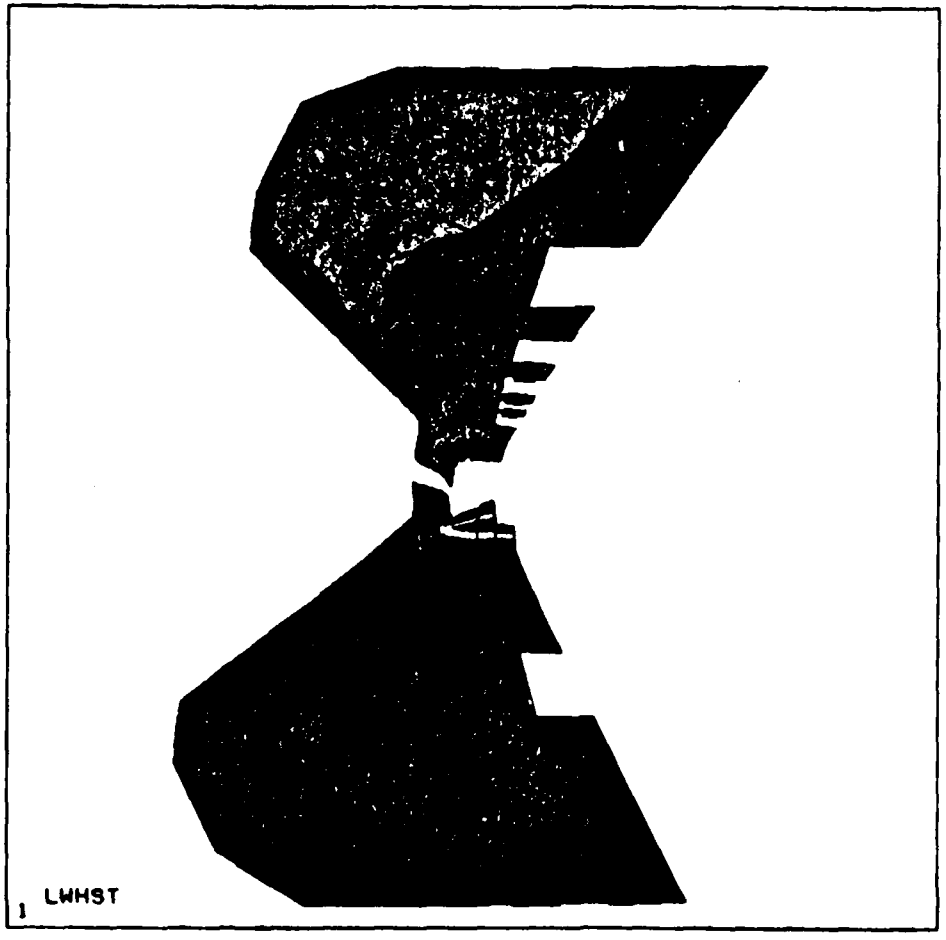
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=7500
MN=-7777
-6082
-4384
-2686
-988
710



ANSYS 4.2B
FEB 27 1987
4:11:19
PLOT NO. 37
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=9475
MN=-9150
-7082
-5012
-2942
-872
1198

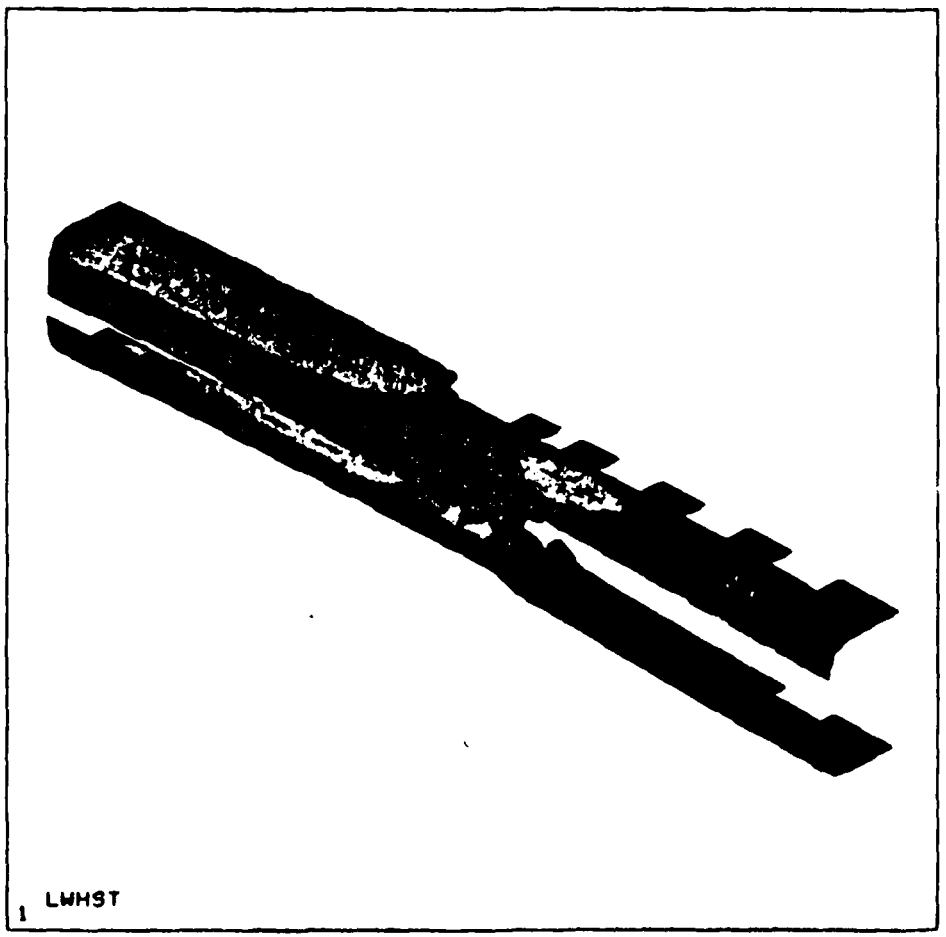
7408
9478



ANSYS 4.2B
FEB 27 1987
4:11:34
PLOT NO. 38
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

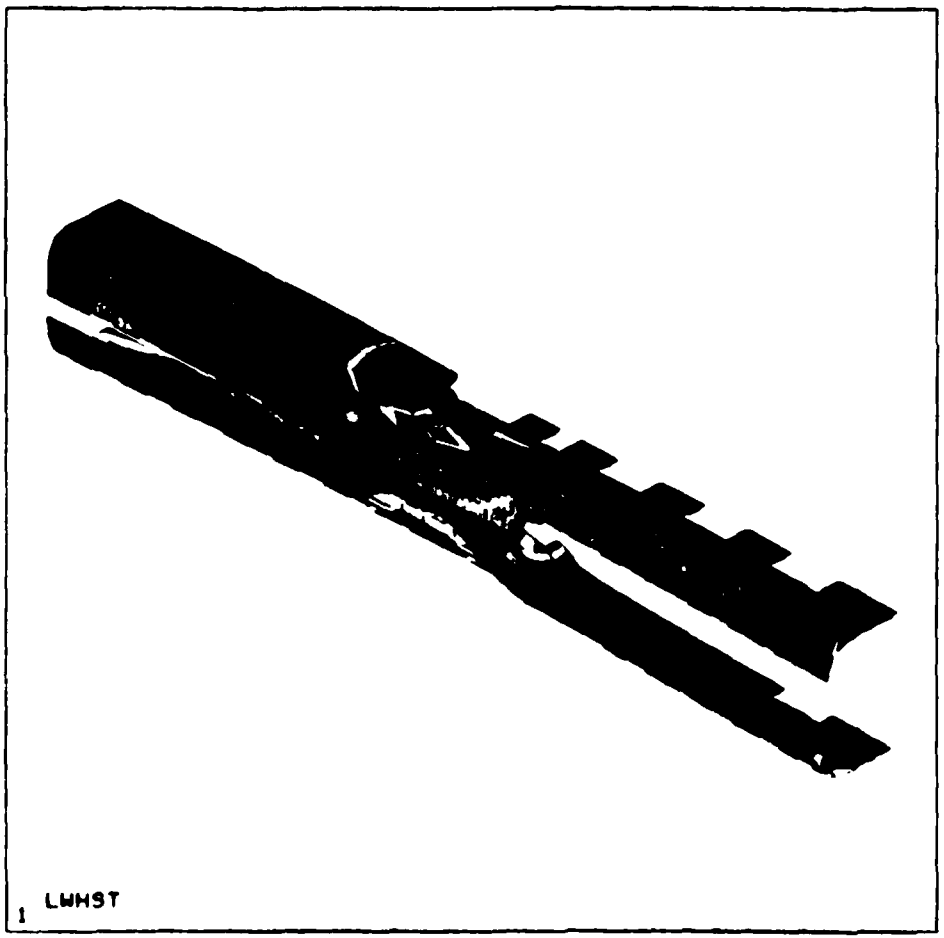
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=7500
MN=-7777
-6082
-4384
-2686
-988
710

5804
7502



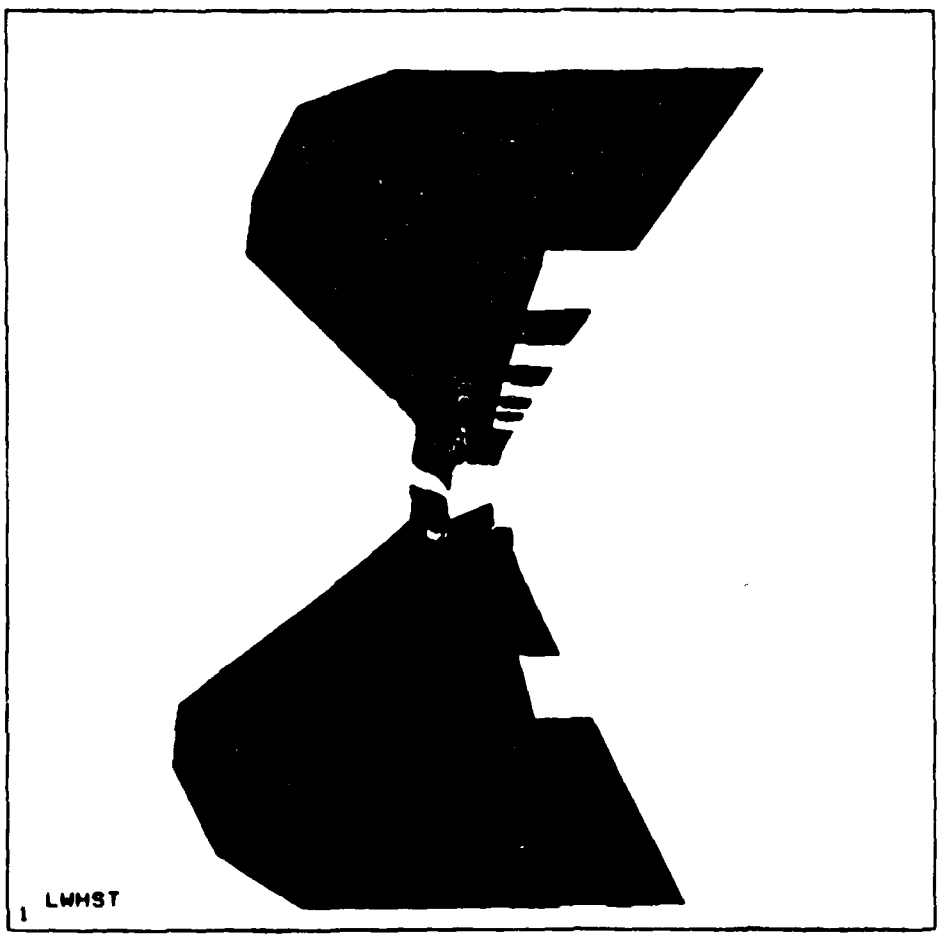
ANSYS 4.2B
FEB 27 1987
4:12:00
PLOT NO. 39
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=12674
MN=-11621
-8923
-6223
-3523
-823
1877



ANSYS 4.2B
FEB 27 1987
4:12:15
PLOT NO. 40
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

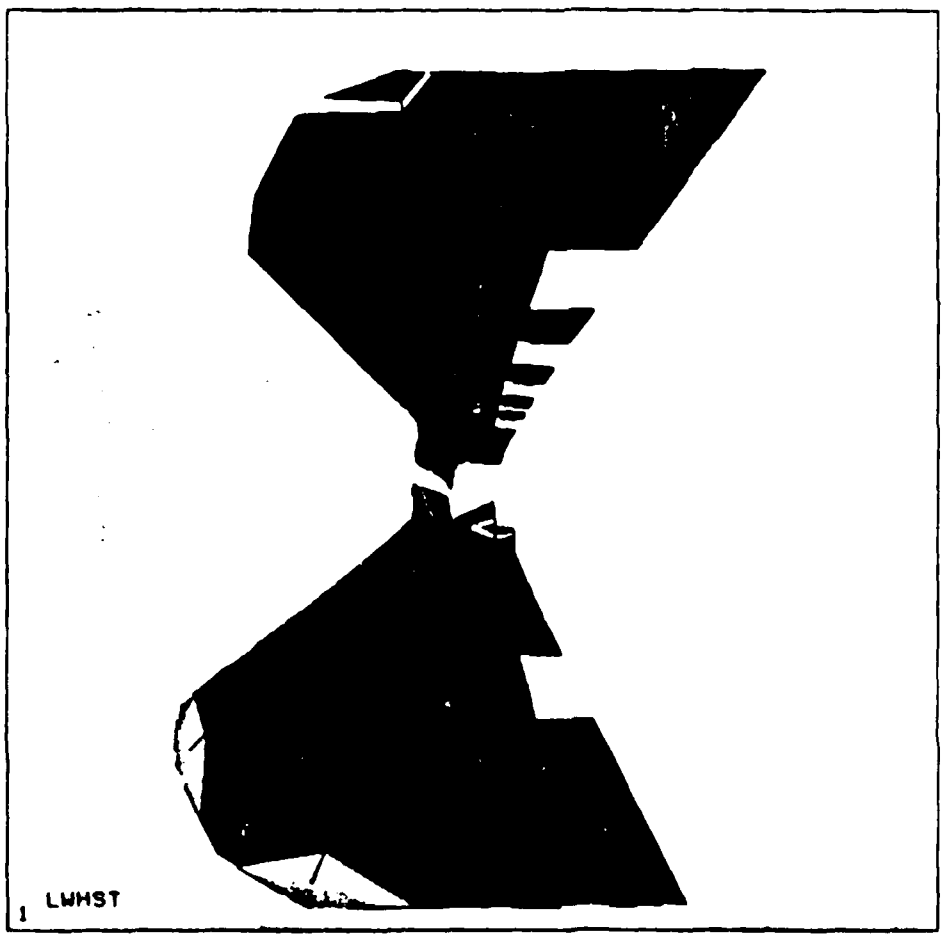
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=5376
MN=-6886
-5526
-4163
-2800
-1437
-73.8



ANSYS 4.2B
FEB 27 1987
4:12:30
PLOT NO. 41
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=12674
MN=-11621
-8923
-6223
-3523
-823
1877

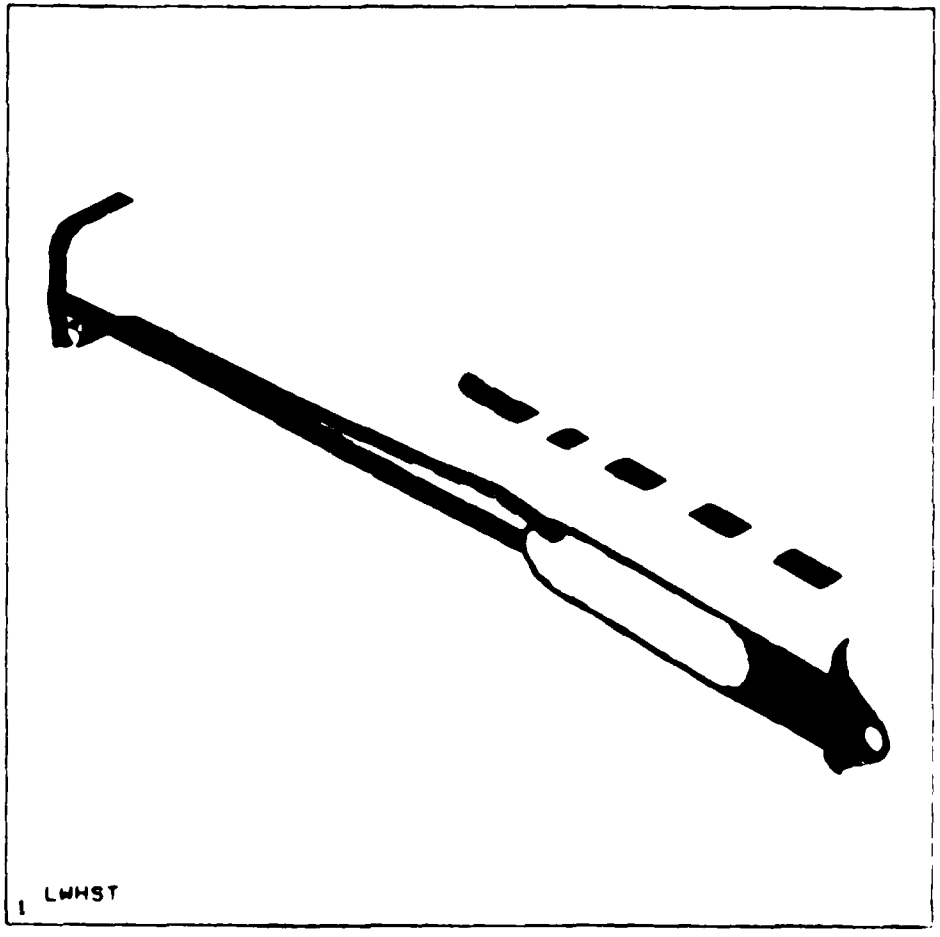
9977
12677



ANSYS 4.2B
FEB 27 1987
4:12:47
PLOT NO. 42
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

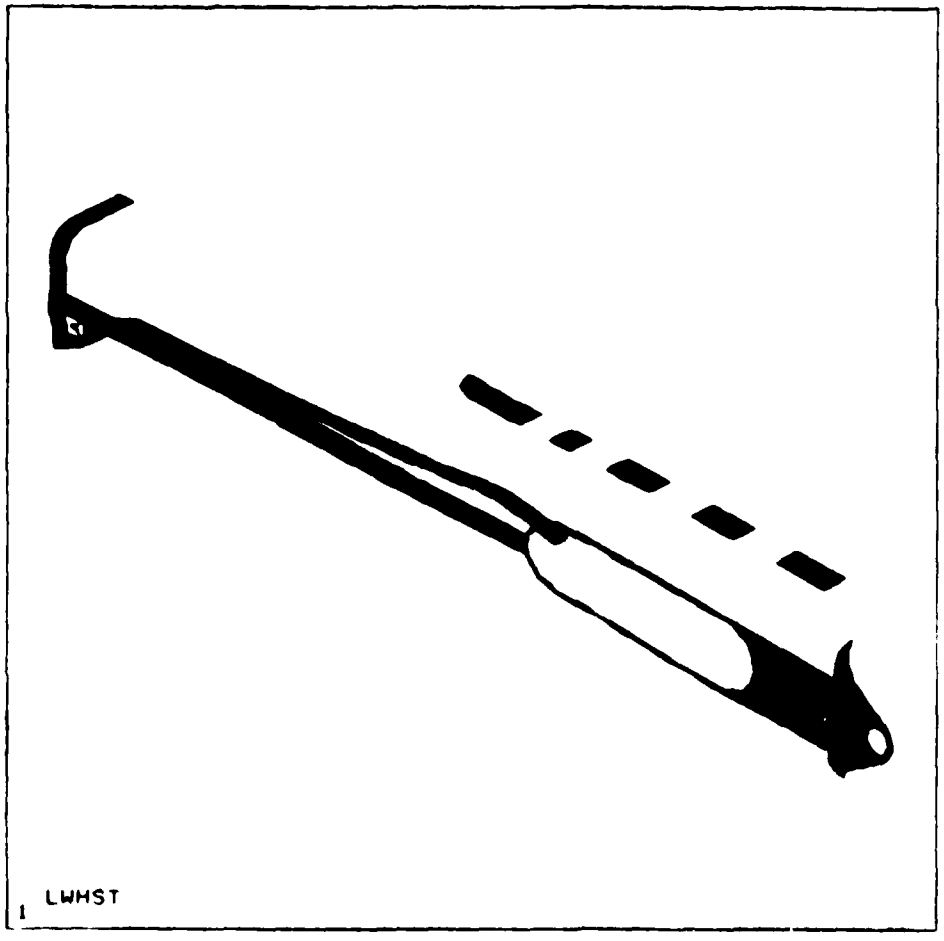
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=5376
MN=-6886
-5526
-4163
-2800
-1437
-73.8

4015
5378



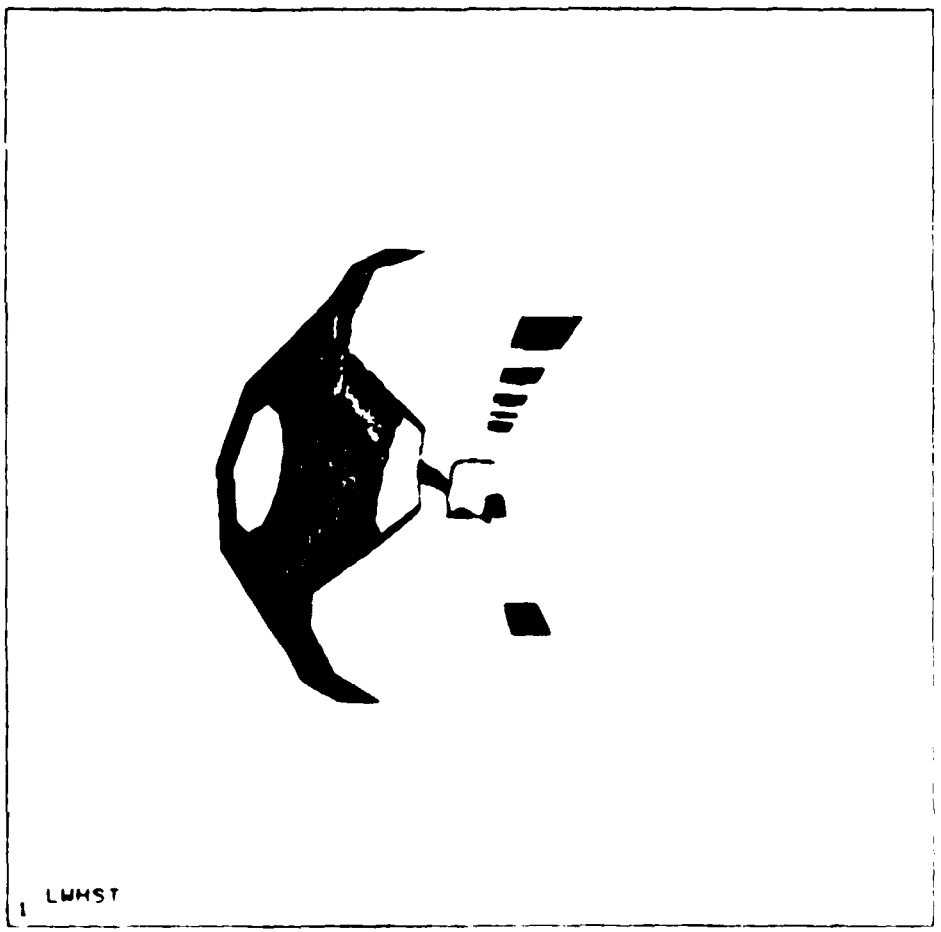
ANSYS 4.2B
FEB 27 1987
4:13:18
PLOT NO. 43
POST1 STRES
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=30849
MN=-36395
-28925
-21453
-13981
-6509
961



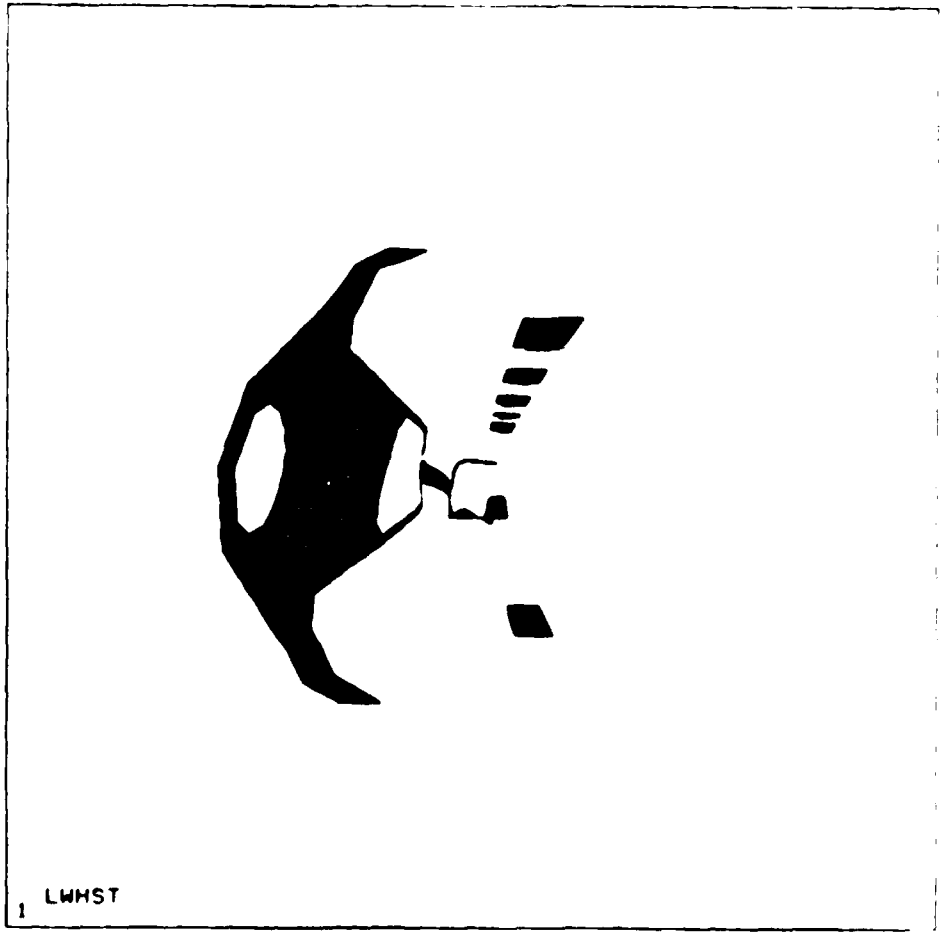
ANSYS 4.2B
FEB 27 1987
4:13:26
PLOT NO. 44
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=47052
MN=-38579
-29066
-19551
-10036
-521
9994



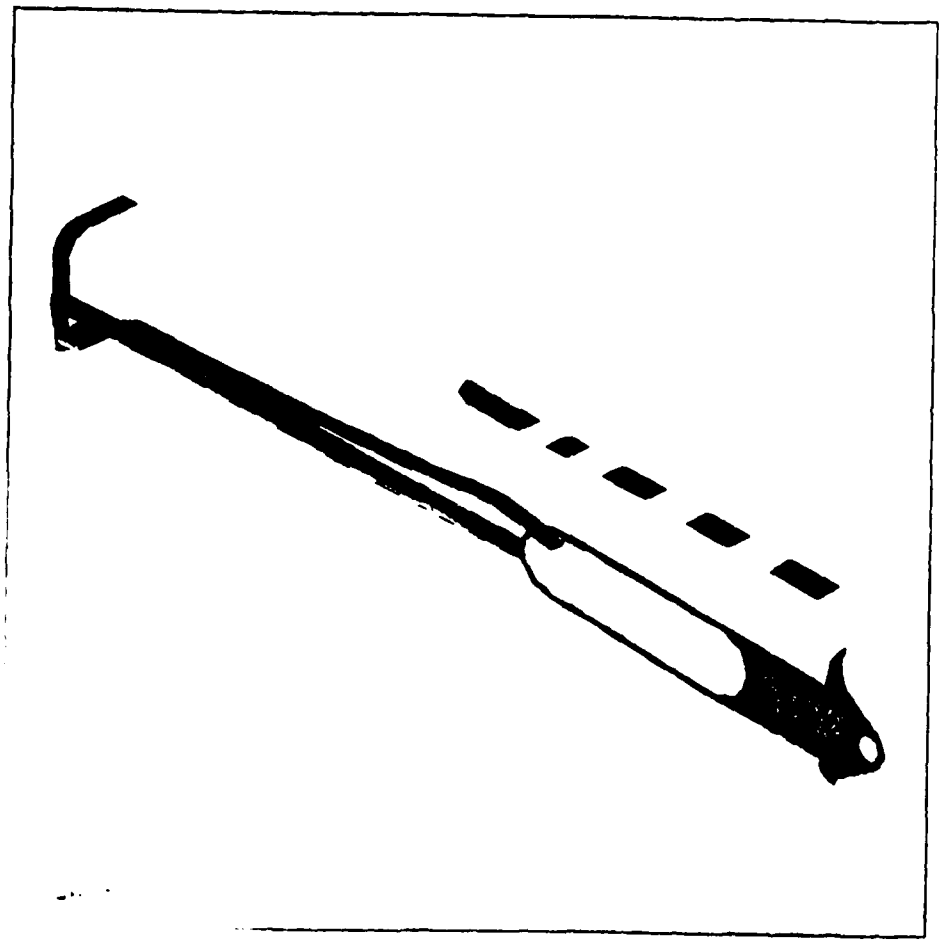
ANSYS 4 2B
FEB 27 1987
4:13:33
PLOT NO. 45
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=.30849
MN=-.36395
-.28925



ANSYS 4 2B
FEB 27 198
4 13:43
PLOT NO 46
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9 5
ZF=-119
CONE=40
HIDDEN
MX=47052
MN=-38529
29066

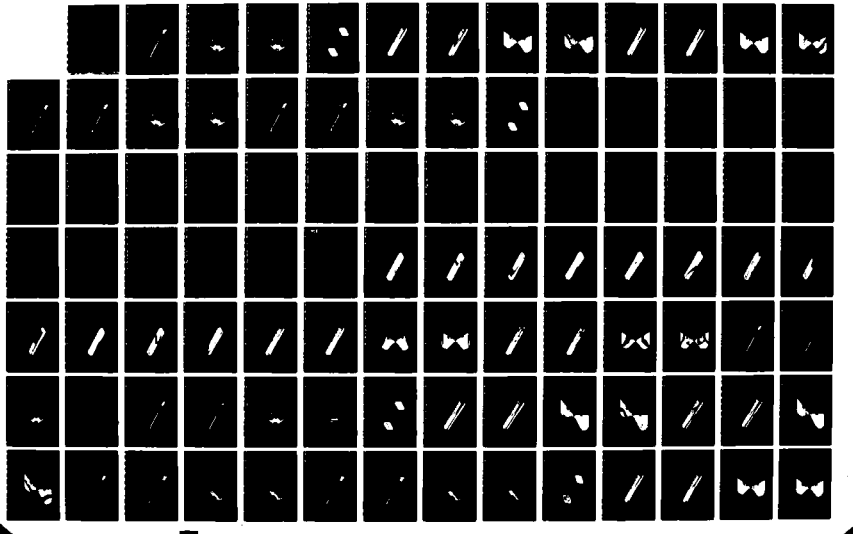


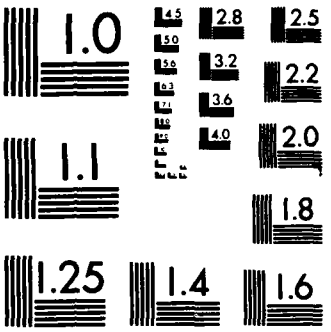
ANSYS 4.2B
FEB 27 1987
4:13:59
PLOT NO. 47
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=20465
MN=-20619
-16055
-11490
-6925
-2360
2205

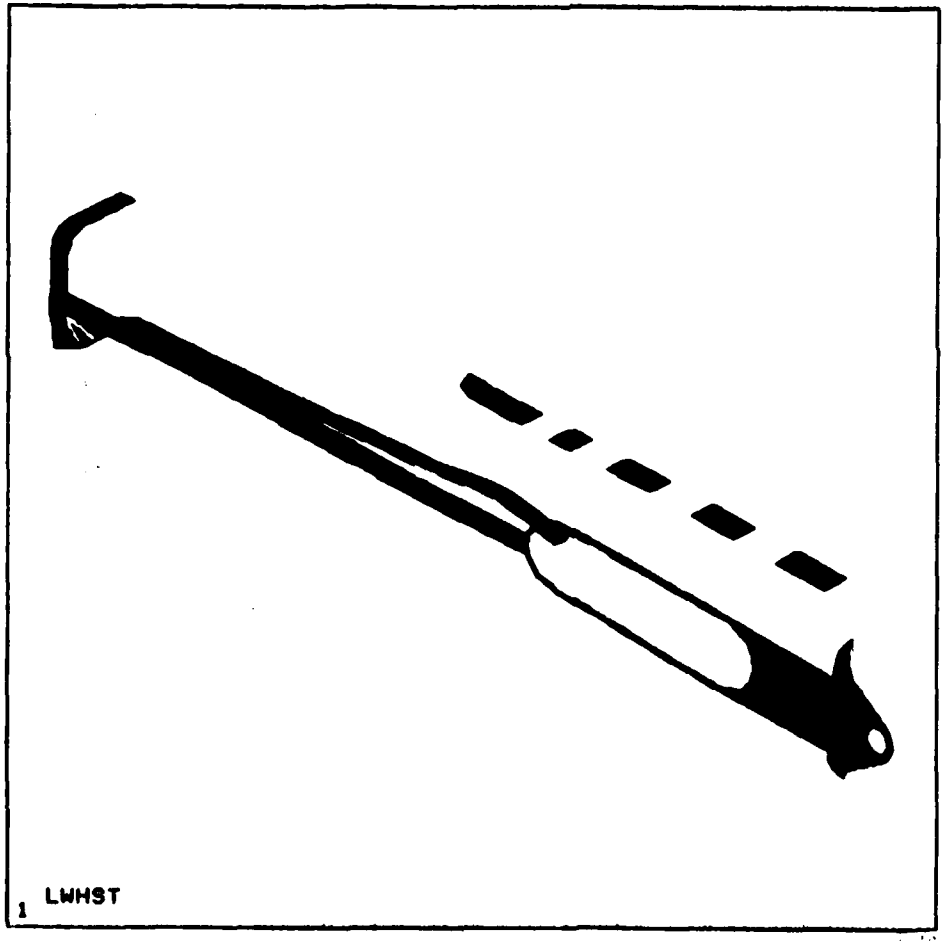
AD-A183 991 LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN NORTHERN ORDNANCE DIV R RATHE ET AL APR 87 4/5

UNCLASSIFIED FMC-E-3041-VOL-D2-PT-3 DAAA21-86-C-0047 F/G 19/6 NL



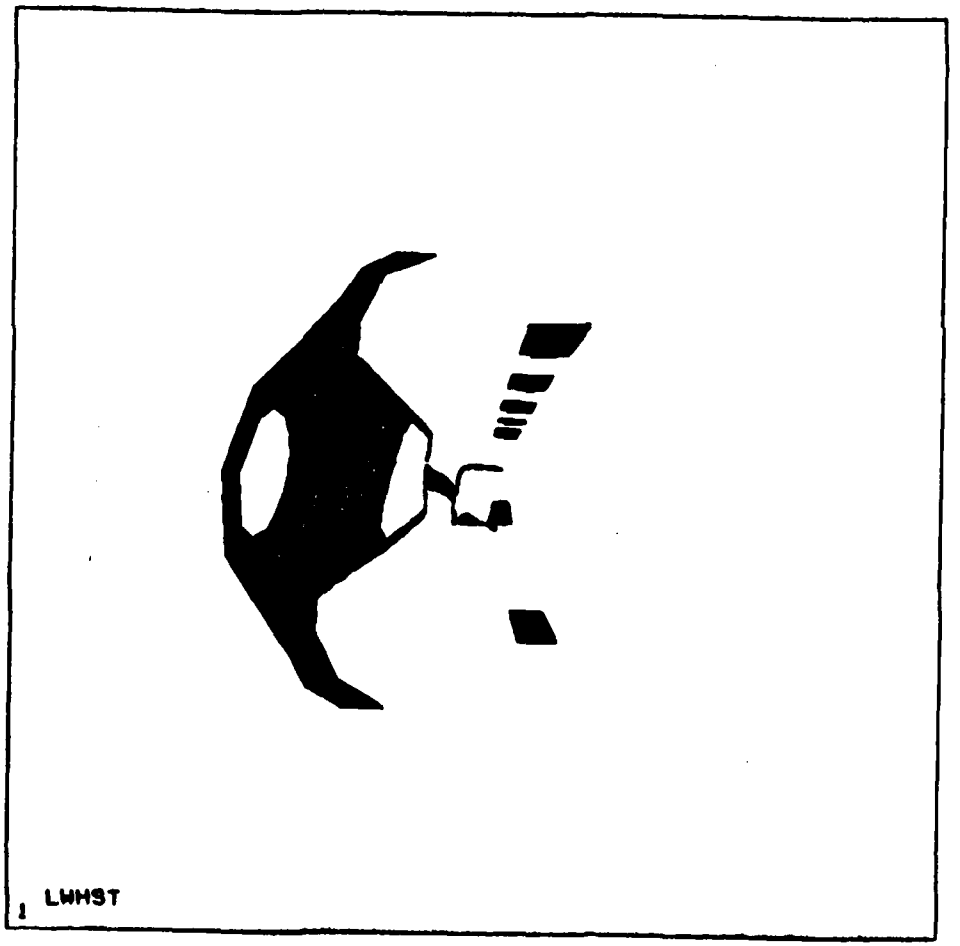


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



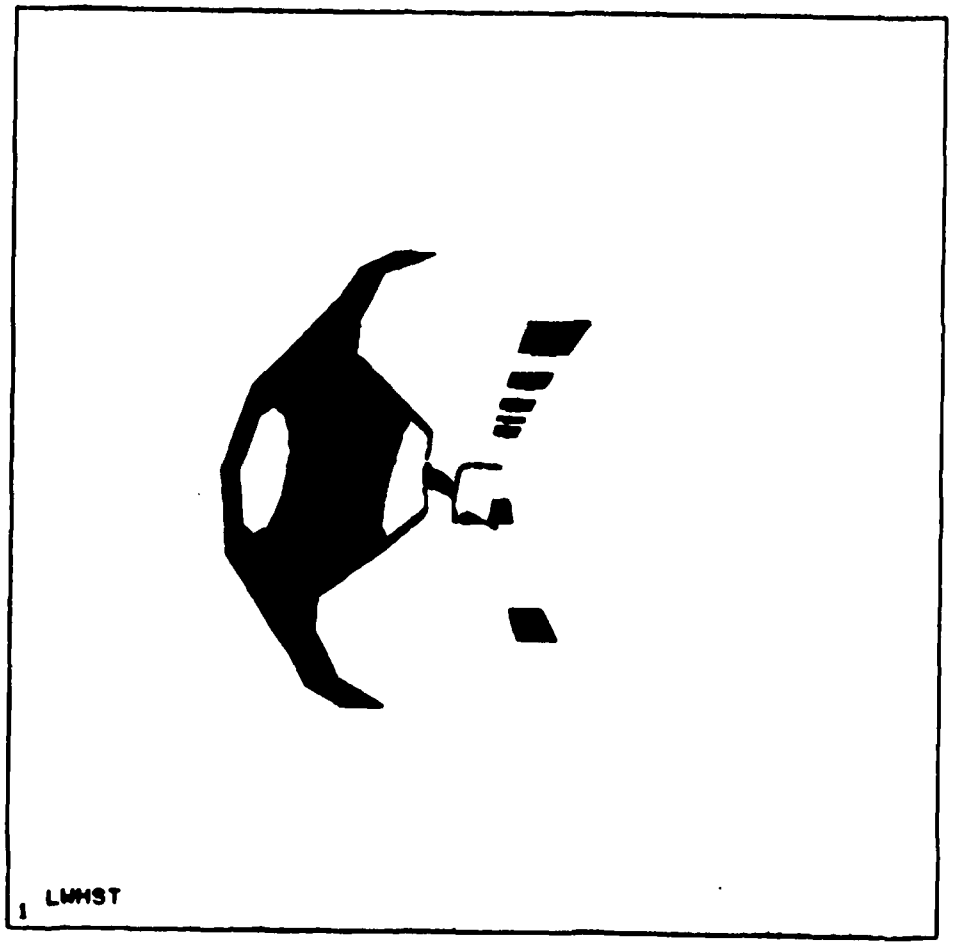
ANSYS 4.2B
FEB 27 1987
4:14:07
PLOT NO. 48
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=31900
MN=-21974
-15988
-10002
-4016
1970
7956



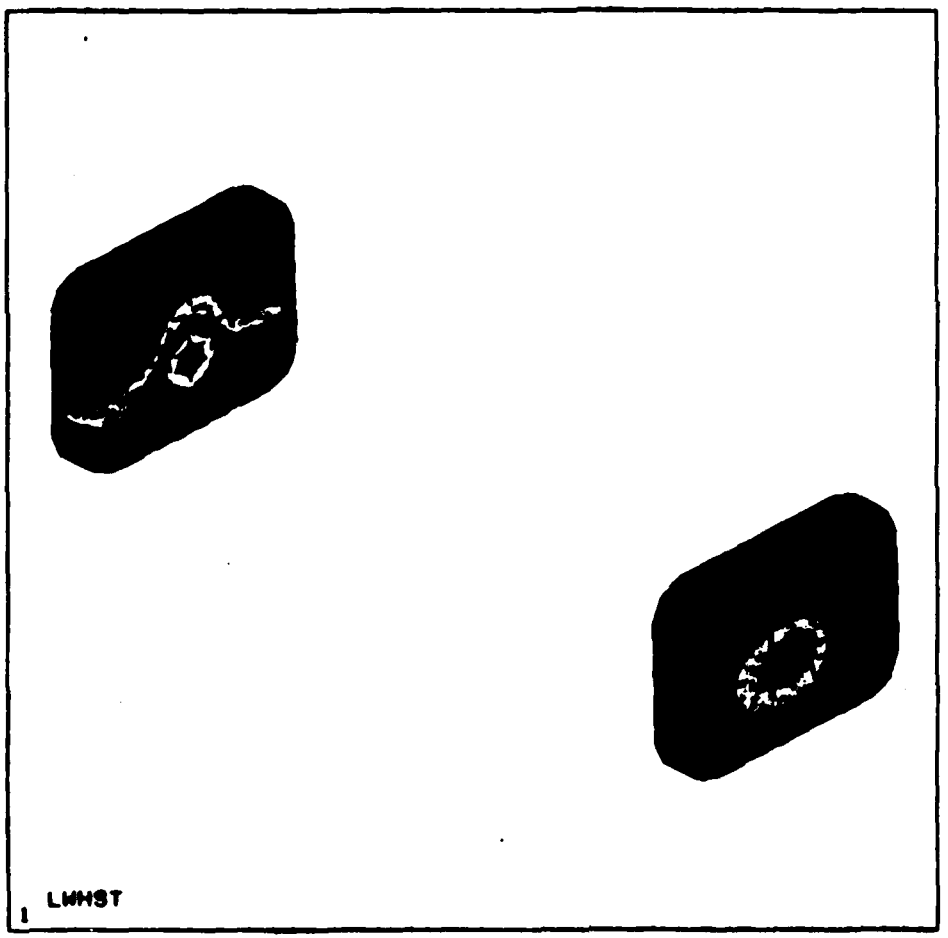
ANSYS 4.2B
FEB 27 1987
4:14:14
PLOT NO. 49
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=20465
MN=-20619
-16055
-11490
-6925
-2360
2205
[illegible]
[illegible]
15900
20465



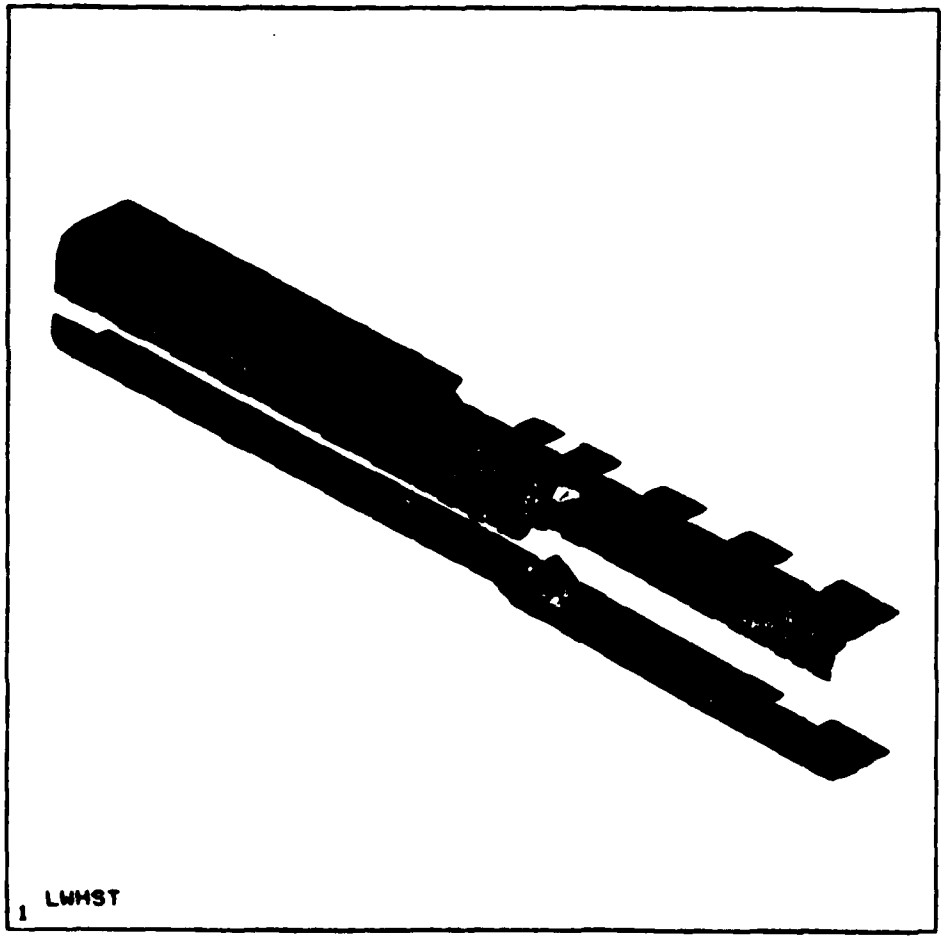
ANSYS 4.2B
FEB 27 1987
4:14:24
PLOT NO. 50
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=31900
MN=-21974
-15988
-10002
-4016
1970
7956
[illegible]
[illegible]
25914
31900



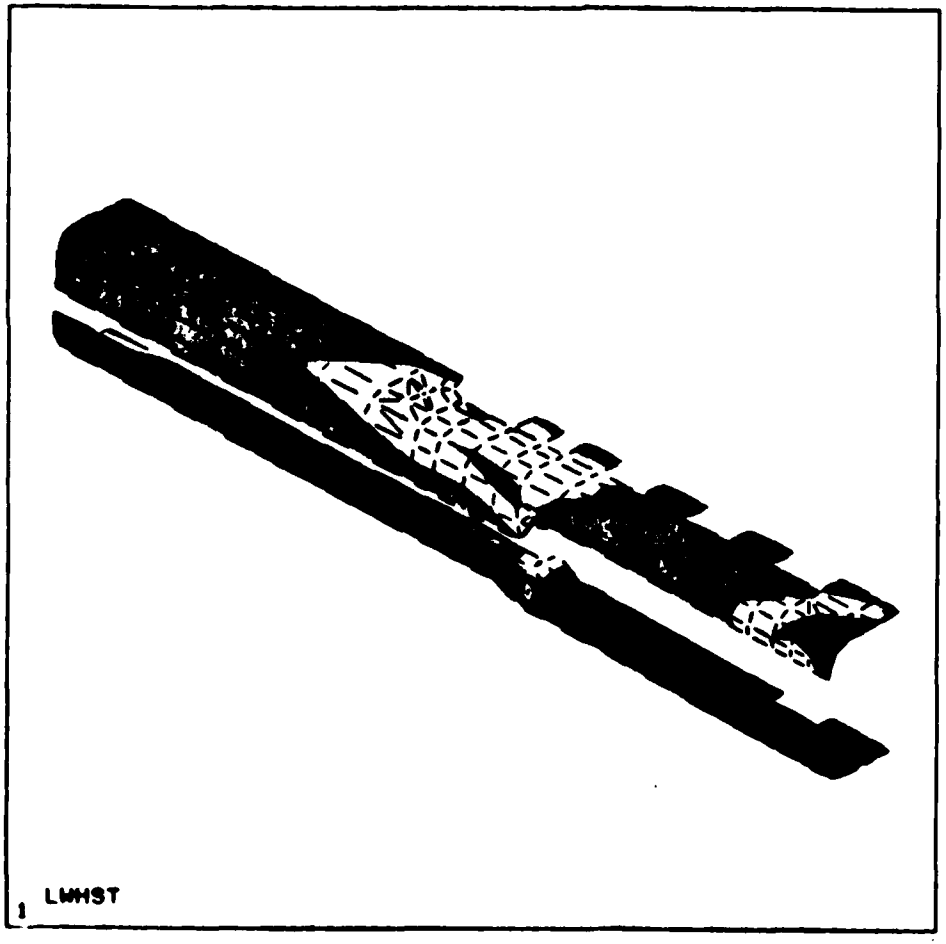
ANSYS 4.2B
FEB 27 1987
4:14:45
PLOT NO. 51
POST1 STRESS
STEP=3
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=862
MN=22.3
113
207
301
395
489
583
677
771
865



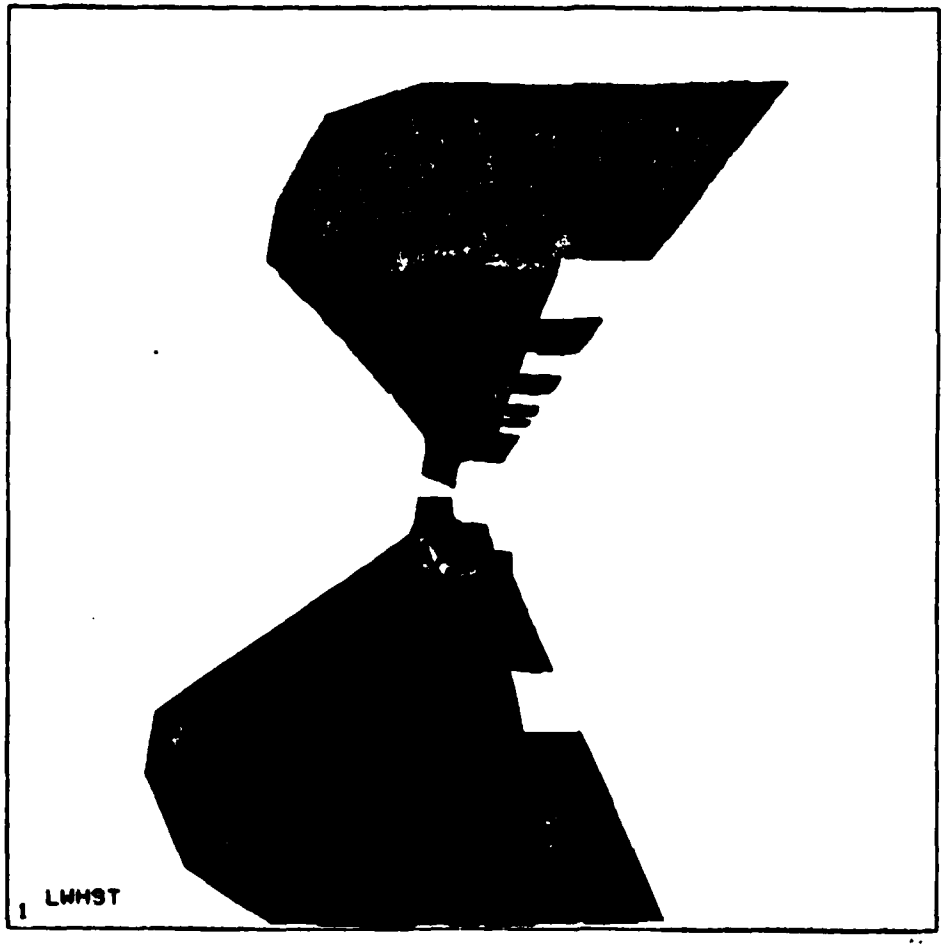
ANSYS 4.2B
FEB 27 1987
4:16:17
PLOT NO. 52
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=19097
MN=-25019
-20118
-15216
-10314
-5412
-510



ANSYS 4.2B
FEB 27 1987
4:16:35
PLOT NO. 53
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=15472
MN=-21550
-17438
-13324
-9210
-5096
-982

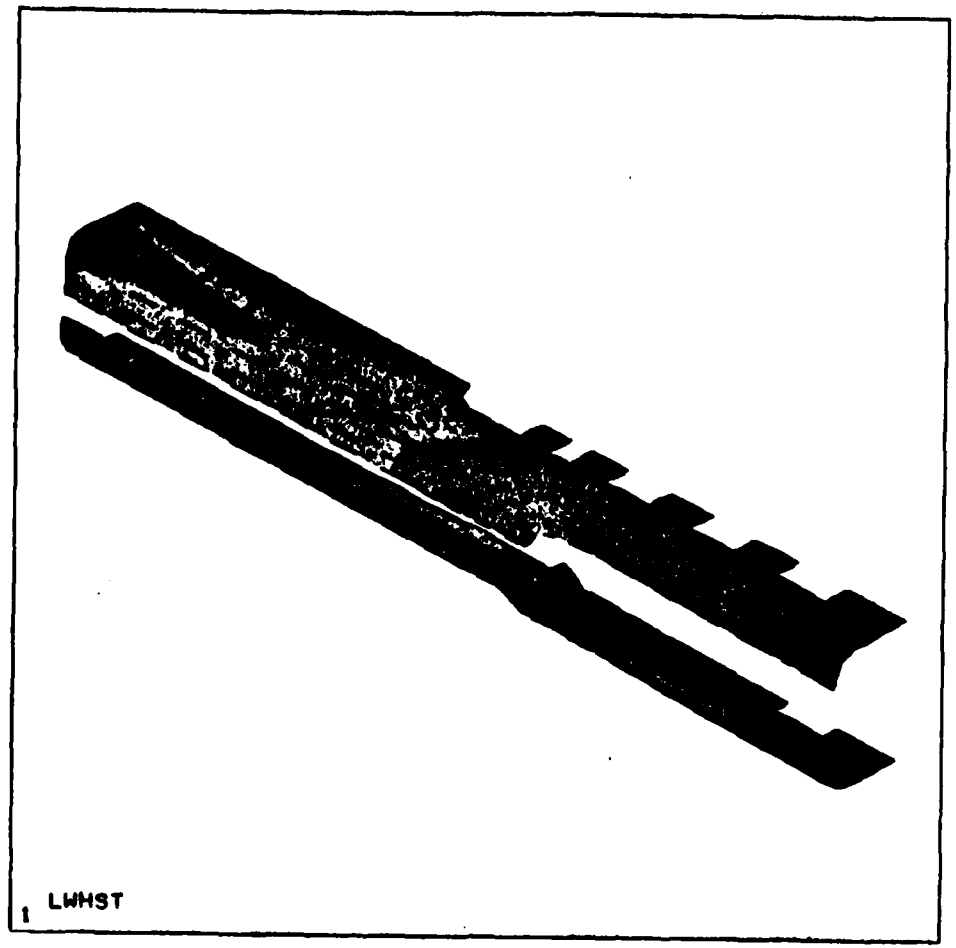


ANSYS 4.2B
FEB 27 1987
4:16:52
PLOT NO. 54
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=19097
MN=-25019
-20118
-15216
-10314
-5412
-510
14196
19098

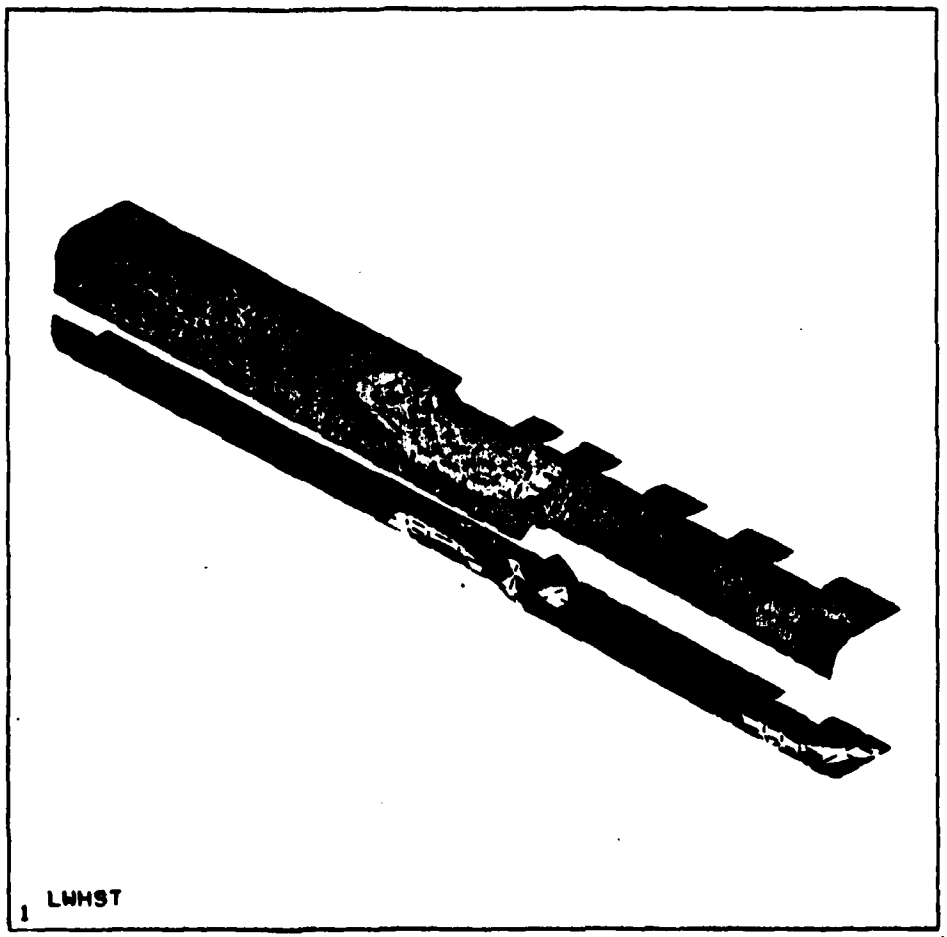
ANSYS 4.2B
FEB 27 1987
4:17:07
PLOT NO. 55
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=15472
MN=-21550
-17438
-13324
-9210
-5096
-982
11360
15474



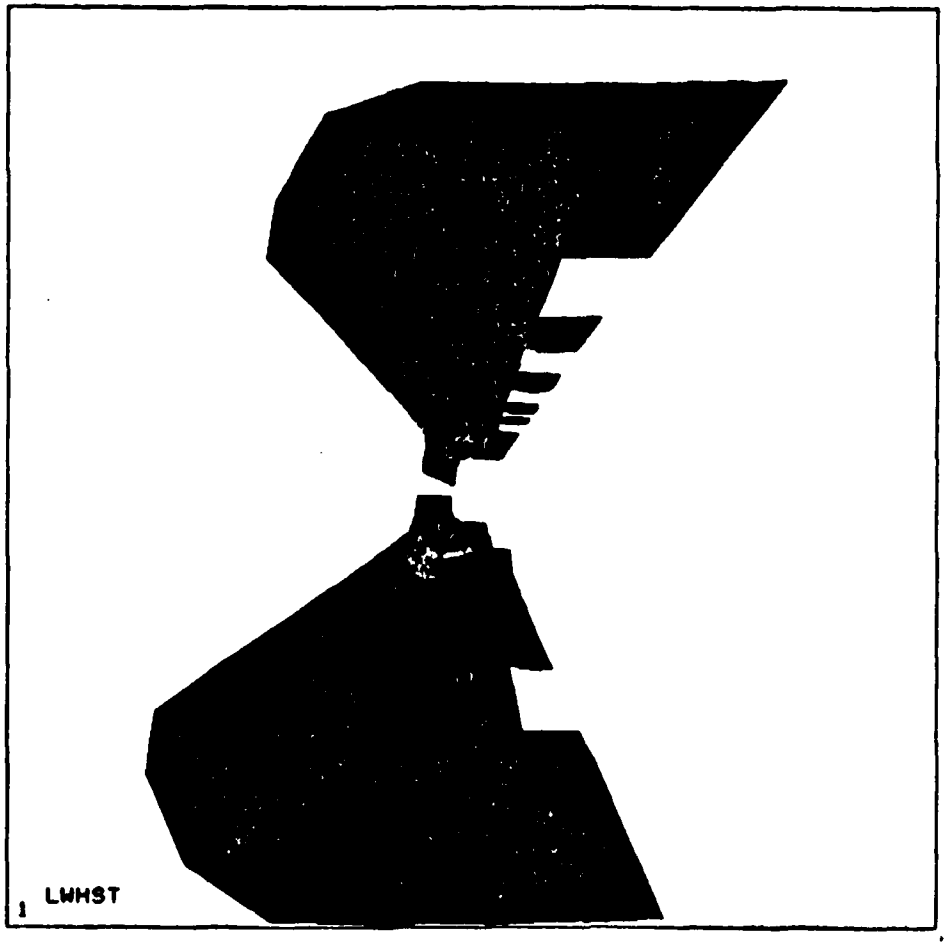
ANSYS 4.2B
FEB 27 1987
4:17:33
PLOT NO. 56
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=26797
MN=-25043
-19283
-13523
-7763
-2003
3757



ANSYS 4.2B
FEB 27 1987
4:17:49
PLOT NO. 57
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=13330
MN=-12270
-9427
-6582
-3737
-892
1953



ANSYS 4.2B
FEB 27 1987
4:18:03
PLOT NO. 58
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

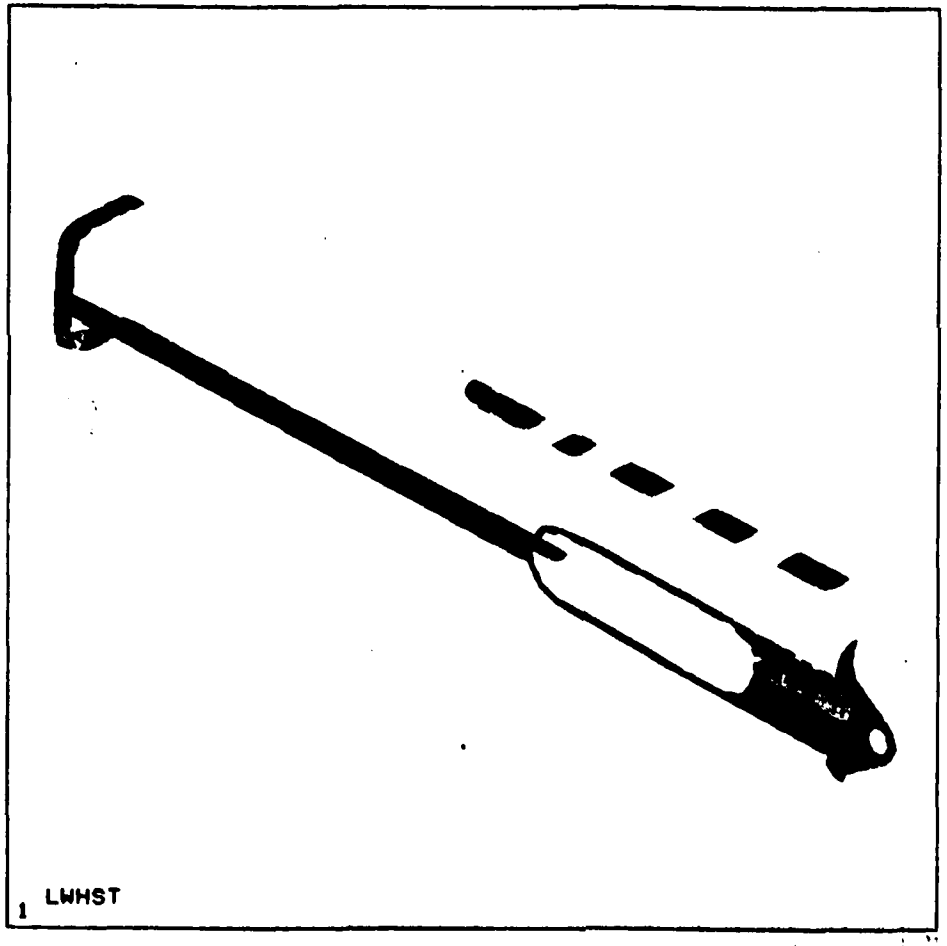
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=26797
MN=-25043
-19283
-13523
-7763
-2003
3757

21037
26797

ANSYS 4.2B
FEB 27 1987
4:18:19
PLOT NO. 59
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

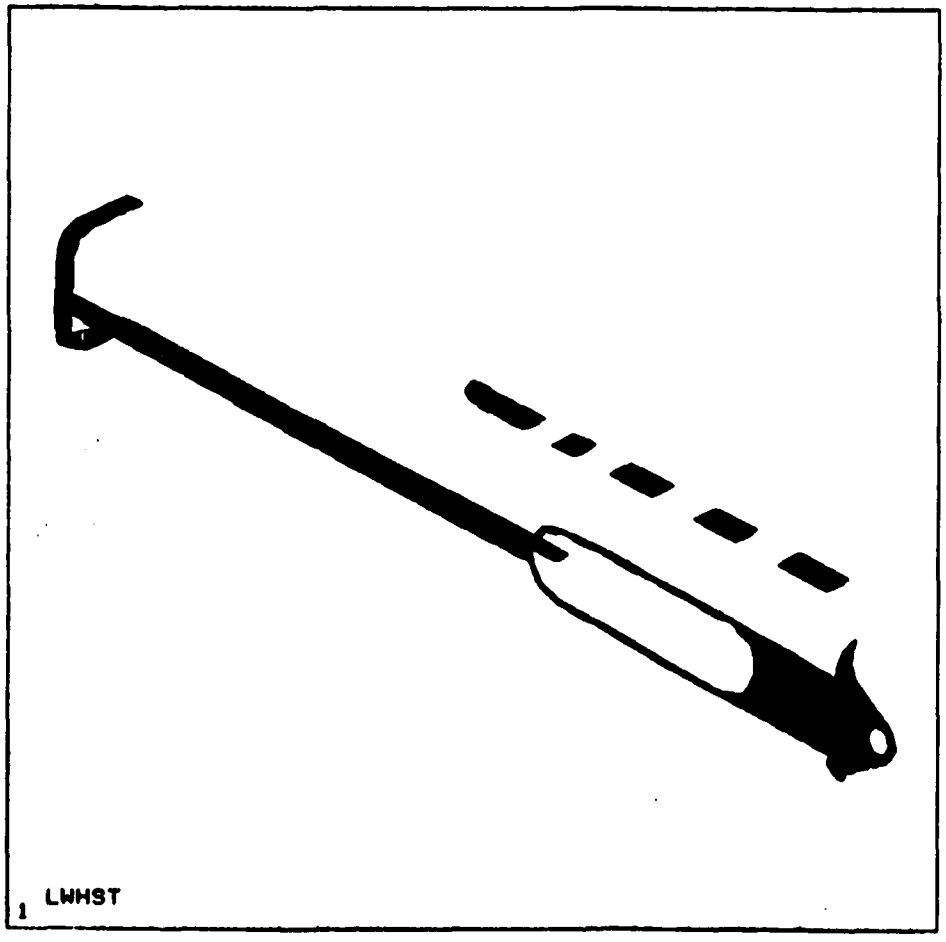
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=13330
MN=-12270
-9427
-6582
-3737
-892
1953

10488
13333



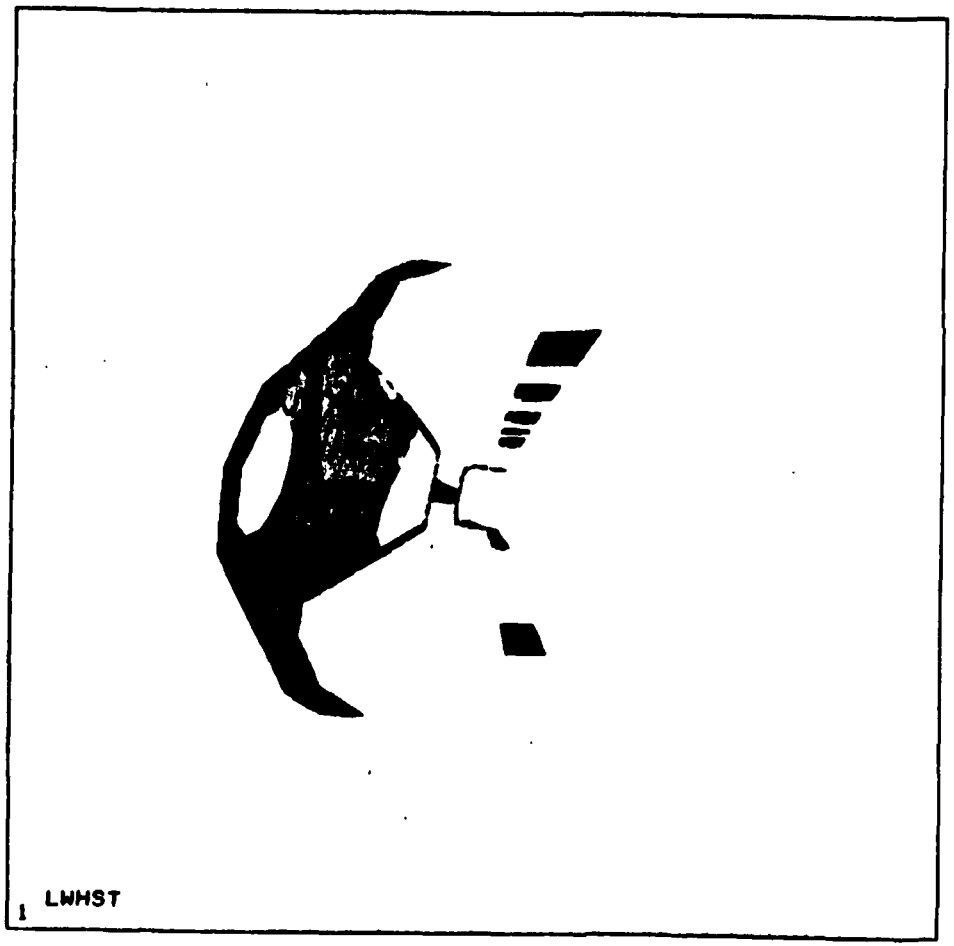
ANSYS 4.2B
FEB 27 1987
4:18:51
PLOT NO. 60
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=74180
MN=-89803
-71585
-53364
-35143
-16922
1299



ANSYS 4.2B
FEB 27 1987
4:18:58
PLOT NO. 61
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

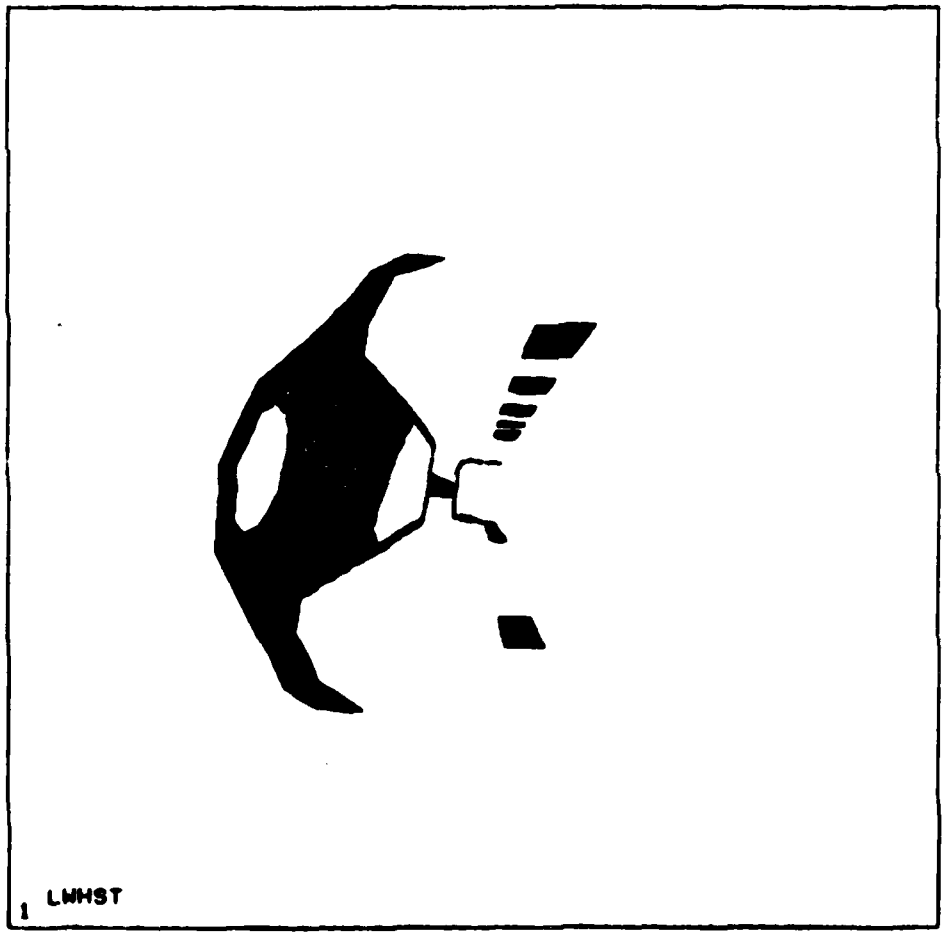
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=107909
MN=-96974
-74210
-51445
-28680
-5915
16850



ANSYS 4.2B
FEB 27 1987
4:19:08
PLOT NO. 62
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=74180
MN=-89803
-71585
-53364
-35143
-16922
1299

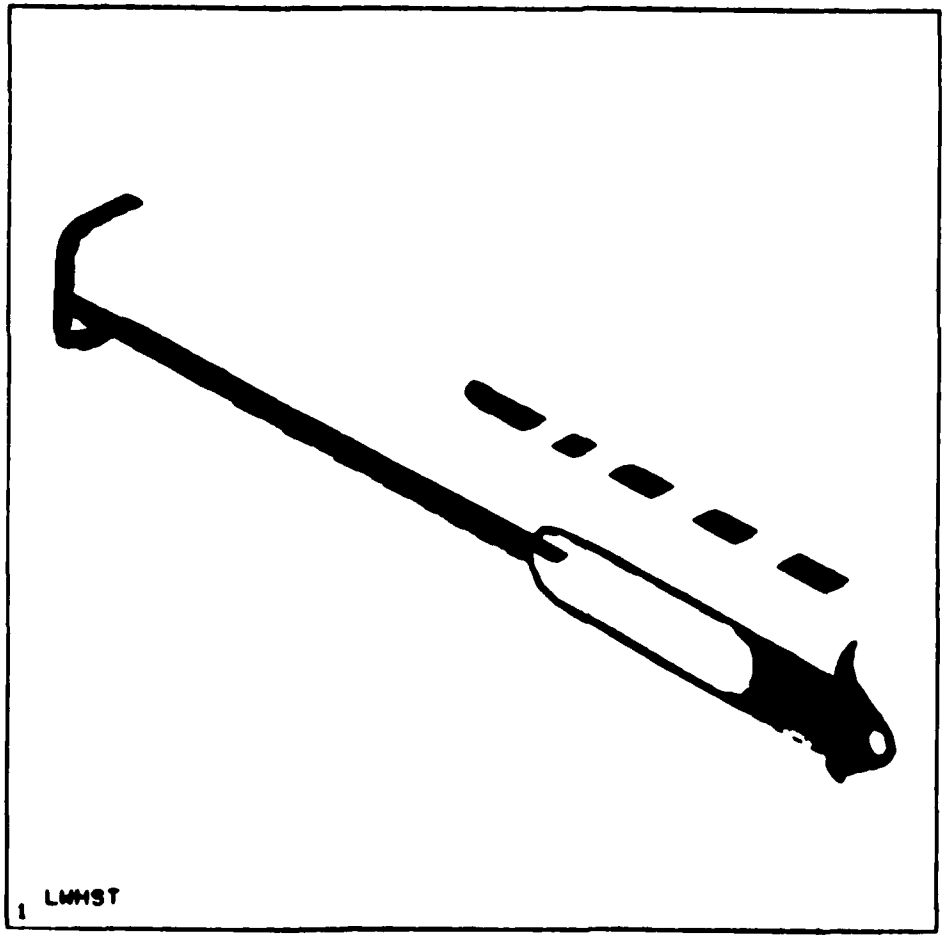
55962
74183



ANSYS 4.2B
FEB 27 1987
4:19:15
PLOT NO. 63
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

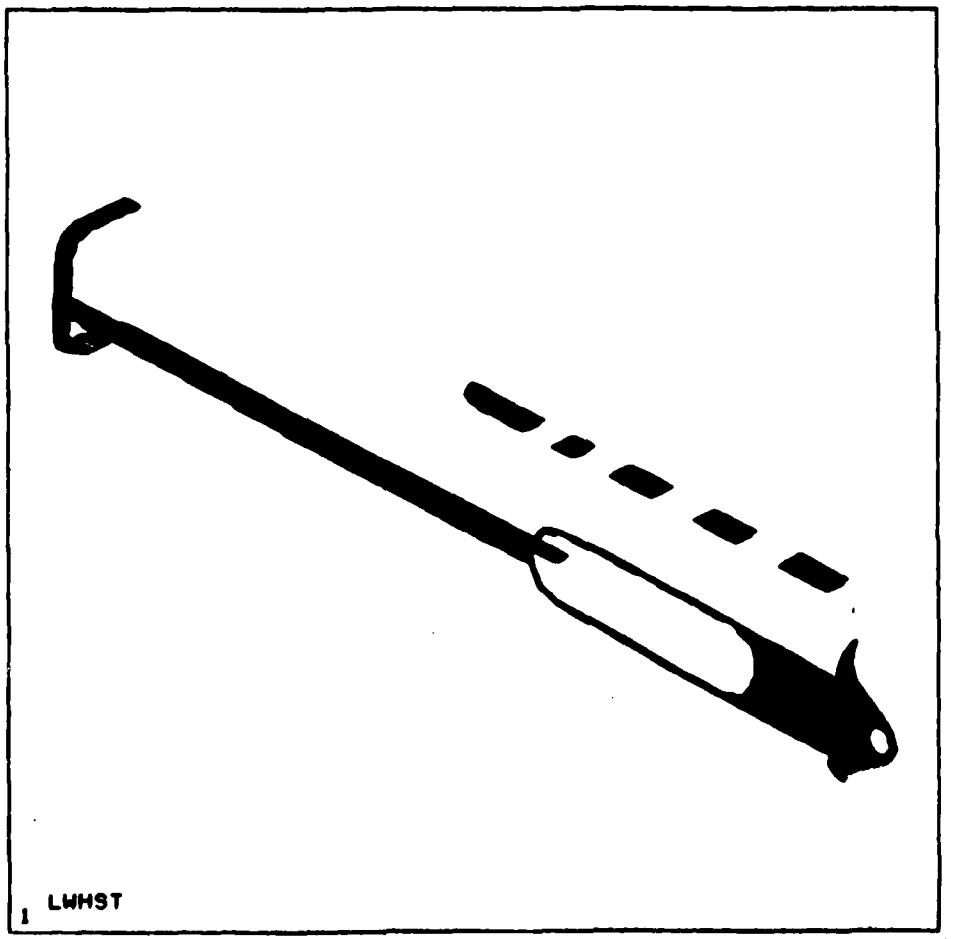
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=107909
MN=-96974
-74210
-51445
-28680
-5915
16850

85145
107910



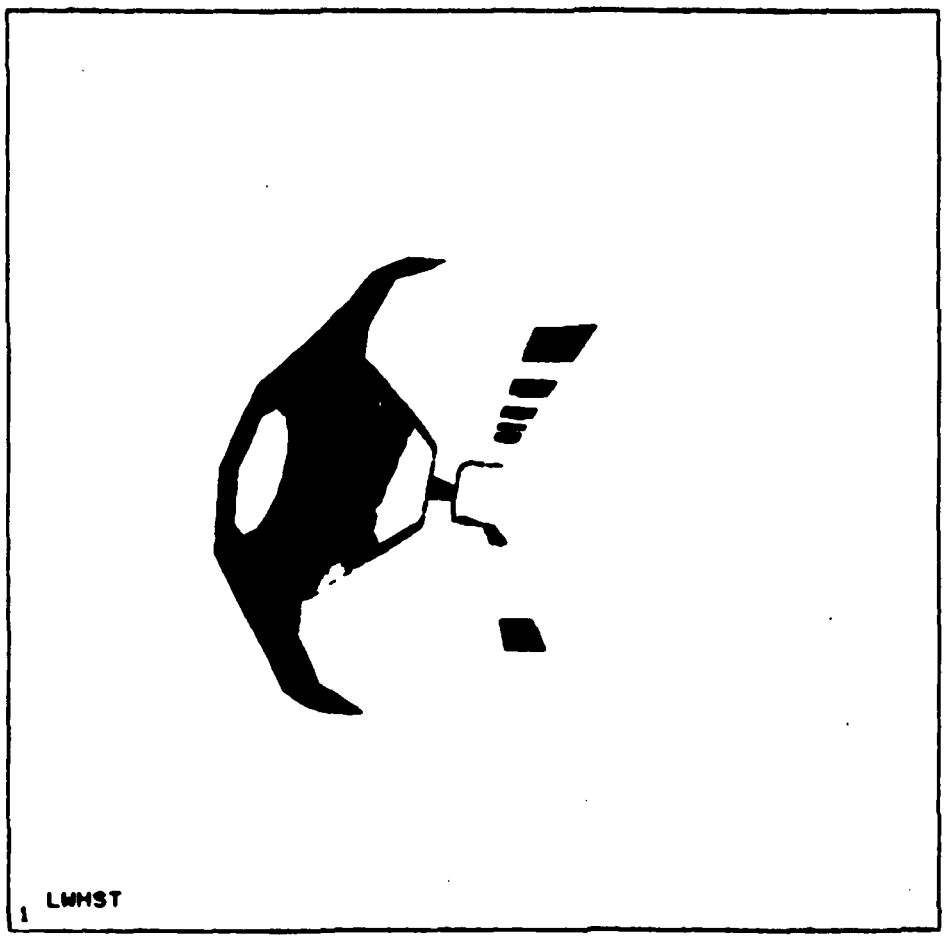
ANSYS 4.2B
FEB 27 1987
4:19:32
PLOT NO. 64
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=82.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=50735
MN=-47651
-36720
-25788
-14856
-3924
7008



ANSYS 4.2B
FEB 27 1987
4:19:40
PLOT NO. 65
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

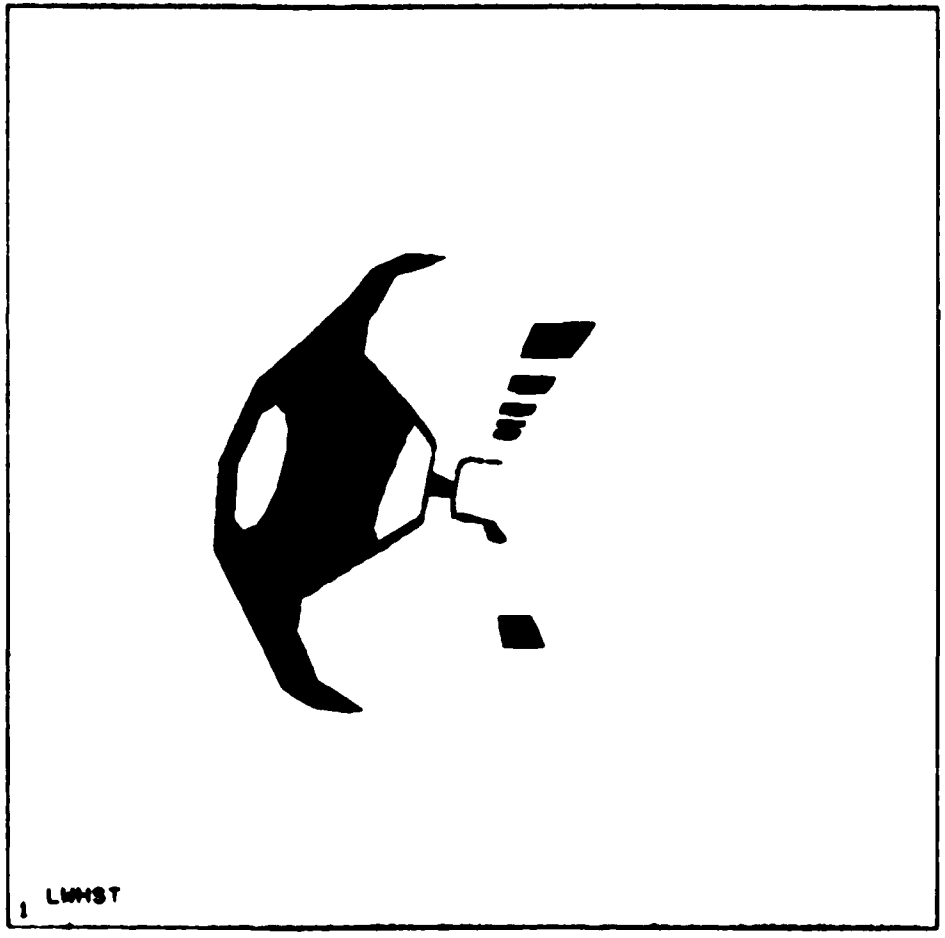
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=70696
MN=-55271
-41277
-27280
-13283
714
14711



ANSYS 4.2B
FEB 27 1987
4:19:49
PLOT NO. 66
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=50735
MN=-47651
-36720
-25788
-14856
-3924
7008

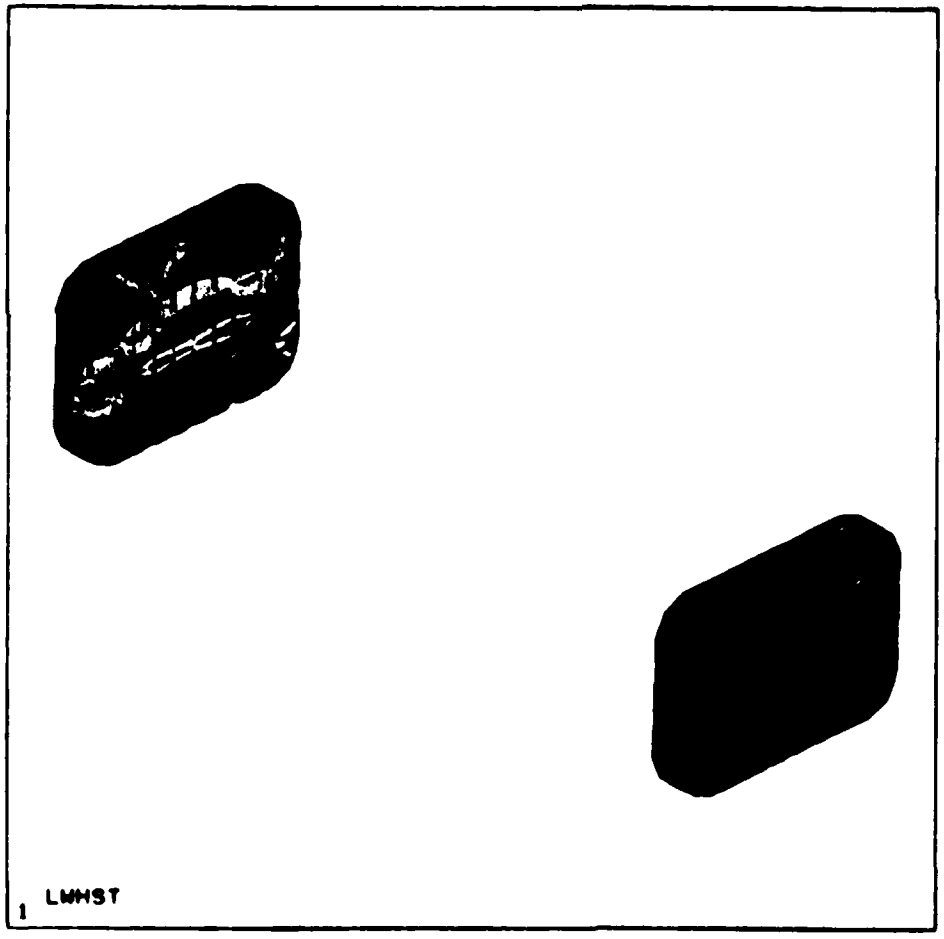
39804
50736



ANSYS 4.2B
FEB 27 1987
4:19:57
PLOT NO. 67
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
MIDDEN
MX=70696
MN=-55271
-41277
-27280
-13283
714
14711

56702
70699



ANSYS 4.2B
FEB 27 1987
4:20:18
PLOT NO. 68
POST1 STRESS
STEP=4
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2665
MN=15.9
308
603
898
1193
1488

2373
2668

COMPUTER RESULTS - MODEL 13

PARK

/PCR/MARK/FMC/M13/CUT.PTYP

PSTOC3, 377 LINES.

Model 13

3-2-87
LJL

2

```
**********  ANSYS INPUT DATA LISTING (FILE18)  **********

/CORE,,,2000000
/PMODE,2
/POST1
STRESS,FAX,4,1
*SET,I,1,1
*BEGIN,MAC
SET,I,1
NRSE,,10001,10012
PRDI
ERSE,STIF,4
PRST
EALL
*END
*DO,MAC,1,3
FINI
/EOF

***** MEMORY REQUEST FROM /CORE *****
 MAXIMUM FIXED  =        0
 MAXIMUM TEMP   =        0
 MAXIMUM VIRTUAL= 2000000

***** MEMORY OBTAINED *****
 FIXED  =  640000
 TEMP   =        0
 VIRTUAL= 2000000

PLOTS PUT ON FILE33 FOR PLOT33 (FASTER MODE)
```

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK NODAMAKER    PHONE (408) 736-1636    TWX

/POST1                                                                  10.6011  FEB 27,1987 CP=      2.257

        ***** ANSYS RESULTS INTERPRETATION (POST1) *****

STORE FAR   FOR ELEMENT TYPE STIF  4  FROM ITEM     1

PARAMETER= I        1.000       1.000       0.

BEGIN MACRO PAC

USE LOAD STEP     1  ITERATION     1  SECTION   1  FOR LOAD CASE     1


*** NOTE ***  FILE12 CONTAINS STIF91 ELEMENTS.
     MID STRESSES ARE NOT AVAILABLE FOR THESE ELEMENTS.
     SELECT TOP OR BOTTOM STRESSES.

GEOMETRY STORED FOR  10014  NODES   1119  ELEMENTS
 TITLE=  LWHST

DISPLACEMENT STORED FOR10014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     1  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2668  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

4

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 A      (PER)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK MCBANAKER    PHONE (412) 746-3304    TWX

 LWNST                                                                10.0500  FEB 27,1987 CP=      46.383

        ***** POST1 NODAL DISPLACEMENT LISTING *****

 LOAD STEP     1  ITERATION=     1  SECTION=  1
 TIME=   0.              LOAD CASE= 1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

   NODE       UX              UY              UZ             ROTX            ROTY            ROTZ
  10001  -0.32043547E-02  -2.9504597       0.          0.93136C30E-02 -0.72146792E-05  0.18C23608E-04
  10002  -0.22405647E-02  -1.8350626       0.          0.93136C21E-02 -0.72146792E-05  0.18C23602E-04
  10003  -0.22576826E-02  -1.7792725       0.          0.93215180E-02 -0.725013C2E-05  0.18C20354E-04
  10004  -0.19C8959EE-02  -1.2916C38       0.          0.94157505E-02 -0.759214C3E-05  0.17682F66E-04
  10005  -0.15186771E-02  -0.8C136551      0.          0.94240261E-02 -0.73892C45E-05  0.173453776-04
  10006  -0.14728433E-02  -0.74488C9C      0.          0.94220240E-02 -0.736177716-05  0.17333267E-04
  10007   0.              0.              0.          0.63436762E-02  0.              0.24586599E-03
  10008   0.13577427E-01  -0.8C248693     -0.14215323  0.70587217E-02  0.74515C10E-04  0.17140783E-03
  10009  -0.62813697E-03  -1.7794470     -0.31619625  0.92039C28E-02 -0.48C90679E-03 -0.12755941E-04
  10010   0.              0.              0.          0.63692431E-02  0.             -0.23119311E-03
  10011  -0.17494735E-01  -0.8C3C9126     -0.14313524  0.70627674E-02 -0.10410990E-03 -0.14995355E-03
  10012  -0.32984464E-02  -1.7802845     -0.31619561  0.92033948E-02  0.46903760E-03  0.49250959E-04

 MAXIMUMS
 NODE       10011           10001           10011          10005           10009           10007
 VALUE   -0.17494735E-01  -2.9504597      -0.31619561  0.94240261E-02 -0.48090679E-03  0.24586R99E-03

 ESEL  FOR LABEL= STIF  FROM     4 TO     4 BY    1

    4  ELEMENTS (OF 1119  DEFINED) SELECTED BY  ESEL  COMMAND.

 PRINT ELEMENT STRESS ITEMS PER ELEMENT
```

Record only

5

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
    (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL MARK RODAMAKER    PHONE (408) 736-1636    TWX

LWHST                                                                  10.6511  FEB 27,1987 CP=     47.613

        ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP     1  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        FAX
1108     1076.6390
1109     1076.6390
1110     1103.5025
1111     1103.5025

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

END MACRO

EXECUTE MACRO MAC    3 TIMES WITH MULTIPLIER FROM    1 TO    3 IN STEPS OF   1

USE LOAD STEP     2  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR10014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     2  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NRSE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2866  DEFINED) SELECTED BY  NRSE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

6

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.2 B (MCR) JUN 1,1985
(C) SWANSON ANALYSIS SYSTEMS, INC. HOUSTON, PENNSYLVANIA 15342
FOR SUPPORT CALL MARK RODAMAKER PHONE (408) 736-1636 TWX

LWNST 10.6750 FEB 27,1967 CP= 71.153

***** POST1 NODAL DISPLACEMENT LISTING *****

LOAD STEP 2 ITERATION= 1 SECTION= 1
TIME= 0. LOAD CASE= 1

Torque only - 42,000 * 0.65

THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
10001	-1.0172050	-0.72082976E-03	0.	0.16811829E-05	-0.41041755E-02	0.39422568E-01
10002	-0.52566897	-0.51949130E-03	0.	0.16811829E-05	-0.41041747E-02	0.39422568E-01
10003	-0.50093463	-0.50942225E-03	0.	0.16627480E-05	-0.40929834E-02	0.39373901E-01
10004	-0.25189950	-0.42136164E-03	0.	0.16992487E-05	-0.39778561E-02	0.38687114E-01
10005	-0.84750664E-01	-0.33303560E-03	0.	0.16944943E-05	-0.40204333E-02	0.38000327E-01
10006	-0.60505099E-01	-0.32288421E-03	0.	0.16936065E-05	-0.40274389E-02	0.37957968E-01
10007	0.	0.	0.	-0.53782283E-02	0.	0.33044305E-01
10008	0.15483470E-01	0.60886842	0.79218339E-01	-0.41042910E-02	-0.92706947E-02	0.35035451E-01
10009	-0.20363803	0.90689616	0.10435435	-0.28247938E-03	-0.49519193E-02	0.39393614E-01
10010	0.	0.	0.	0.53828285E-02	0.	0.33044283E-01
10011	0.15481571E-01	-0.60941645	-0.79315883E-01	0.41085755E-02	-0.92707062E-02	0.35035438E-01
10012	-0.20363804	-0.90791519	-0.10413602	0.28581667E-03	-0.49518630E-02	0.39393625E-01

2.26°

MAXIMUMS

NODE	10001	10012	10011	10010	10011	10001
VALUE	-1.0172050	-0.90791519	-0.10413602	0.53828285E-02	-0.92707062E-02	0.39422568E-01

ERSE FOR LABEL= STIF FROM 4 TO 4 BY 1

4 ELEMENTS (OF 1119 DEFINED) SELECTED BY ERSE COMMAND.

PRINT ELEMENT STRESS ITEMS PER ELEMENT

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B       (MCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK RODAMAKER    PHONE (408) 736-1636    TWX

LWHST                                                                  10.6761  FEB 27,1987 CP=     72.371

        ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP     2  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        FAX
1108     9382.5635
1109     9382.5635
1110    -9381.8327
1111    -9381.8327

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

USE LOAD STEP     3  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR1CC14 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     3  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NBSE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2666  DEFINED) SELECTED BY  NBSE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

```
PRSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
(C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
FOR SUPPORT CALL MARK MCDAMAKER    PHONE (402) 736-1636    TWX

LWHST                                                                  10.6994  FEB 27,1987 CP=     95.925

      ***** POST1 NODAL DISPLACEMENT LISTING *****

LOAD STEP     3  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

  NODE       UX              UY              UZ              ROTX            ROTY            ROTZ
10001  -0.11803282      -1.7076741      0.              0.79790981E-02 -0.47667679E-03  0.46830186E-02
10002  -0.60946010E-01 -0.76173390      0.              0.76458986E-02 -0.47667679E-03  0.46830186E-02
10003  -0.58064855E-01 -0.71643751      0.              0.76329587E-02 -0.47485078E-03  0.46838232E-02
10004  -0.33936461E-01 -0.31306675      0.              0.78977352E-02 -0.45645803E-03  0.47231222E-02
10005  -0.10175072E-01  0.10032146      0.              0.78704630E-02 -0.46458136E-03  0.47624211E-02
10006  -0.73659321E-02  0.14716484      0.              0.78488653E-02 -0.46581490E-03  0.47659949E-02
10007   0.              0.              0.              0.43989764E-02  0.              0.37229177E-02
10008  -0.11280530E-01 -0.34844108     -0.51817459E-01  0.81057289E-03 -0.11653468E-02  0.40224410E-02
10009  -0.23434041E-01 -0.60957759     -0.88514886E-01  0.72752344E-02 -0.18377511E-03  0.46559154E-02
10010   0.              0.              0.              0.56811170E-02  0.              0.41049607E-02
10011   0.16066711E-01 -0.49340135     -0.70614187E-01  0.17839467E-02 -0.10160446E-02  0.42736442E-02
10012  -0.22376018E-01 -0.82415755     -0.11330550      0.73222837E-02 -0.98415318E-03  0.46248575E-02

MAXIMUMS
NODE      10001           10001           10012           10001           10008           10006
VALUE   -0.11803282      -1.7076741     -0.11330550      0.79790981E-02 -0.11653468E-02  0.47659949E-02

ERSE  FOR LABEL= STIF  FROM     4 TO     4 BY    1

   4  ELEMENTS (OF 1119  DEFINED) SELECTED BY  ERSE  COMMAND.

PRINT ELEMENT STRESS ITEMS PER ELEMENT
```

Dead wt. only

9

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK RODAMAKER    PHONE (406) 736-1636    TWX

LWNST                                                                          10.7006  FEB 27,1987 CP=     97.167

        ***** PCST1 ELEMENT STRESS LISTING *****

LOAD STEP     3  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        FAX
1108    -3079.4345
1109    -3077.0862
1110    -5348.5427
1111    -5346.1944

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

LSE LOAD STEP     4  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR1CC14 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     4  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWNST

NASE  FOR LABEL= NODE  FROM 1C001 TO 10012 BY    1

  12  NODES (OF 2868  DEFINED) SELECTED BY  NRIE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.2 B (MCR) JUN 1,1985
(C) SWANSON ANALYSIS SYSTEMS, INC. HOUSTON, PENNSYLVANIA 15342
FOR SUPPORT CALL PARK RCBAMAKER PHONE (406) 736-1636 TWX

LWNST

10.7225 FEB 27,1987 CP= 120.655

***** PCST1 NODAL DISPLACEMENT LISTING *****

combined: Recoil, torque, and Read wt.

LOAD STEP 4 ITERATION= 1 SECTION= 1
TIME= 0. LOAD CASE= 1

THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
10001	-1.0216392	-5.5516957	0.	0.17599421E-01	-0.41141588E-02	0.39447504E-01
10002	-0.52892756	-3.4536257	0.	0.17266222E-01	-0.41141588E-02	0.39447504E-01
10003	-0.50411349	-3.3501723	0.	0.17215628E-01	-0.41030167E-02	0.39398933E-01
10004	-0.29454066	-2.4606559	0.	0.17130619E-01	-0.39883627E-02	0.38711579E-01
10005	-0.88849128E-01	-1.56364C8	0.	0.17359332E-01	-0.40306591E-02	0.38024326E-01
10006	-0.62542874E-01	-1.4592582	0.	0.17369977E-01	-0.40376267E-02	0.37581950E-01
10007	0.	0.	0.	0.10741777E-01	0.	0.32561178E-01
10008	-0.24249539E-01	-1.1586435	-0.18311535	0.80128400E-02	-0.95111710E-02	0.34744863E-01
10009	-0.20728585	-2.4400908	-0.38815773	0.17055877E-01	-0.38249089E-02	0.39575641E-01
10010	0.	0.	0.	0.21510536E-01	0.	0.33547703E-01
10011	0.52562469E-01	-2.3779646	-0.34276144	0.16231304E-01	-0.90711806E-02	0.35355716E-01
10012	-0.20597285	-4.2563608	-0.59716236	0.17623455E-01	-0.60952982E-02	0.39262090E-01

MAXIMUMS

NODE	10001	10001	10011	10010	10008	10009
VALUE	-1.0216392	-5.5516957	-0.59716236	0.21510536E-01	-0.95111710E-02	0.39575641E-01

ESSE FOR LABEL= STIF FROM 4 TO 4 BY 1

4 ELEMENTS (OF 1119 DEFINED) SELECTED BY ERSE COMMAND.

PRINT ELEMENT STRESS ITEMS PER ELEMENT

11

```
        PASYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
    (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL MARK RODAMAKER    PHONE (405) 736-1636    TWX

LWMST                                                                  10.7239  FEB 27,1967 CP=    121.887

        ***** PCST1 ELEMENT STRESS LISTING *****

LOAD STEP     4  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        FAX
1108     -6433.1789
1109     -6450.8306
1110     -25180.391
1111     -25178.043

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  ALL  COMPAND.

***** ROUTINE COMPLETED *****  CP =       122.120

/EOF ENCOUNTERED ON FILE10

***** RUN COMPLETED *****  CP=      122.3310   TIME=   10.7244
```

COMPUTER RESULTS - MODEL 13

Model 13

2

```
**********  ANALYZ INPUT DATA LISTING (FILE19)  **********

    1   /COPY,,,,,,,,,,
    2   /PROG,,2
    3   /POST1
    4   STRESS,PAR,4,1
    5   *SET,I,1,1
    6   *SEEIN,PAC
    7   SET,I,1
    8   NPSE,,10001,10012
    9   PPDI
   10   EPSE,STIF,4
   11   PRST
   12   CALL
   13   *END
   14   *DC,PAC,1,3
   15   FINI
   16   /EOF

***** MEMORY REQUEST FROM /COPY *****
 MAXIMUM FIXED  =        0
 MAXIMUM TEMP   =        0
 MAXIMUM VIRTUAL= 2000000

***** MEMORY OBTAINED *****
 FIXED  =  640000
 TEMP   =        0
 VIRTUAL= 2000000

PLOTS PUT ON FILE33 FOR PLOT33 (MASTER MODE)
```

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM.  REVISION 4.2 R        (PCR)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK RODAMAKER    PHONE (400) 736-1676    TWX

/POST1                                                                    13.1344  PAR  3,1987 CP=      2.231

        ***** ANSYS RESULTS INTERPRETATION (POST1) *****

STORE PAR   FOR ELEMENT TYPE STIF  4  FROM ITE,     1

PARAMETER= I        1.000        1.000       0.

BEGIN MACRO MAC

USE LOAD STEP     1  ITERATION     1  SECTION   1  FOR LOAD CASE     1


*** NOTE ***  FILE12 CONTAINS STIF91 ELEMENTS.
     PID STRESSES ARE NOT AVAILABLE FOR THESE ELEMENTS.
     SELECT TOP OR BOTTOM STRESSES.

GEOMETRY STORED FOR  10014  NODES   1119  ELEMENTS
 TITLE=  LWHST

DISPLACEMENT STORED FOR10014 NODE.

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     1  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2666  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

```
                ANSYS - ENGINEERING ANALYSIS SYSTEM.  REVISION 4.2 A      (PCS)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL TAPE ACCESS AREA     PHONE (412) 746-3304    TWX

 ENDST                                                                  13.1772  MAR  3,1967 CP=     45.870

          ***** PRINT NODAL DISPLACEMENT LISTING *****

 LOAD STEP     1  ITERATION=     1  SUBSTEP=     1
 TIME=   0.              LOAD CASE=   1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

   NODE        UX            UY            UZ            ROTX          ROTY          ROTZ
  10001  -0.2212E-02   -3.9101557      0.          0.99621C41E-02 -0.36920E85E-03  0.171889158-04
  10002  -0.1870E-02   -1.9135644      0.          0.99621C32E-02 -0.36920E85E-03  0.171889158-04
  10003  -0.1846E-02   -1.8336165      0.          0.99645C41E-02 -0.35205E61E-03  0.170772468-04
  10004  -0.1719E-02   -1.9329934      0.          0.10027E64E-01 -0.19620160E-03  0.157750258-04
  10005  -0.1567E-02   -0.6109159      0.          0.10044712E-01 -0.32310420E-03  0.144728058-04
  10006  -0.1577E-02   -0.7967.9C2      0.          0.10045209E-01 -0.33858199E-03  0.143931778-04
  10007    0.            0.            0.          0.84512513E-02   0.            0.246230258-03
  10008   0.1563776E-01  -0.8220C15F    -0.1493.6177  0.73105926E-02  0.70660C89E-04  0.175545408-03
  10009  -0.1567E7.C346-03  -1.9.3.9.2    -0.382.4991  0.99.6.6.07E-02 -0.45.872338-03  0.667191628-06
  10010    0.            0.            0.          0.84577129E-02   0.            -0.23C352615-03
  10011  -0.1.6177.5E-01  -0.3225U471    -0.1493.6557  0.73142101E-02 -0.95650891E-04 -0.153740C9E-03
  10012  -0.1.8414715-02  -1.P.4.E.      -0.3.3.6642  0.99.274.2E-02  0.46351940E-03  0.343160138-04

 PRINPWR
 NODE        10011          10001          10003          10004          10006          10007
 VALUE   -0.1.6172458-01  -3.9101987     -0.383.6642  0.10045709E-01 -0.45697233E-03  0.246230258-03

 BASE  FOR LABEL= STEP  SEC=     4 TO     4 BY    1

    *  ELEMENTS (OF TYPE  DEFINED) SELECTED BY  ESEL  COMMAND.

 PRINT ELEMENT STRESS ITEMS PER ELEMENT
```

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          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 *        (MCP)          JUN 1,1985
     (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL MARK MCDAMAKER    PHONE (403) 735-1636    TWX

 LWNST                                                                    13.1776  MAR  3,1987 CP=     47.063

        ***** POST1 ELEMENT STRESS LISTING ***

 LOAD STEP     1  ITERATION=     1  SECTION=  1
 TIME=   0.              LOAD CASE=  1

 ELEM        FAX
 1108    -5.1562092
 1109    -5.1562032
 1110     9.0397421
 1111     9.0397542

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

END MACRO

EXECUTE MACRO MAC    3 TIMES WITH MULTIPLIER FROM    1 TO    3 IN STEPS OF   1

USE LOAD STEP     2  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR 10014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     2  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWNST

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2666  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

5

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                ANSYS - ENGINEERING ANALYSIS SYSTEM,  REVISION 4.2 -        (VAX)          JUN 1,1988
     (C) 1984,84 ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
     FOR SUPPORT CALL DATA CORPORATION    PHONE (412) 928-1678    TWX

 LOAD STEP     2  ITERATION=     1  SECTION=  1
 TIME=   0.                LOAD CASE=  1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

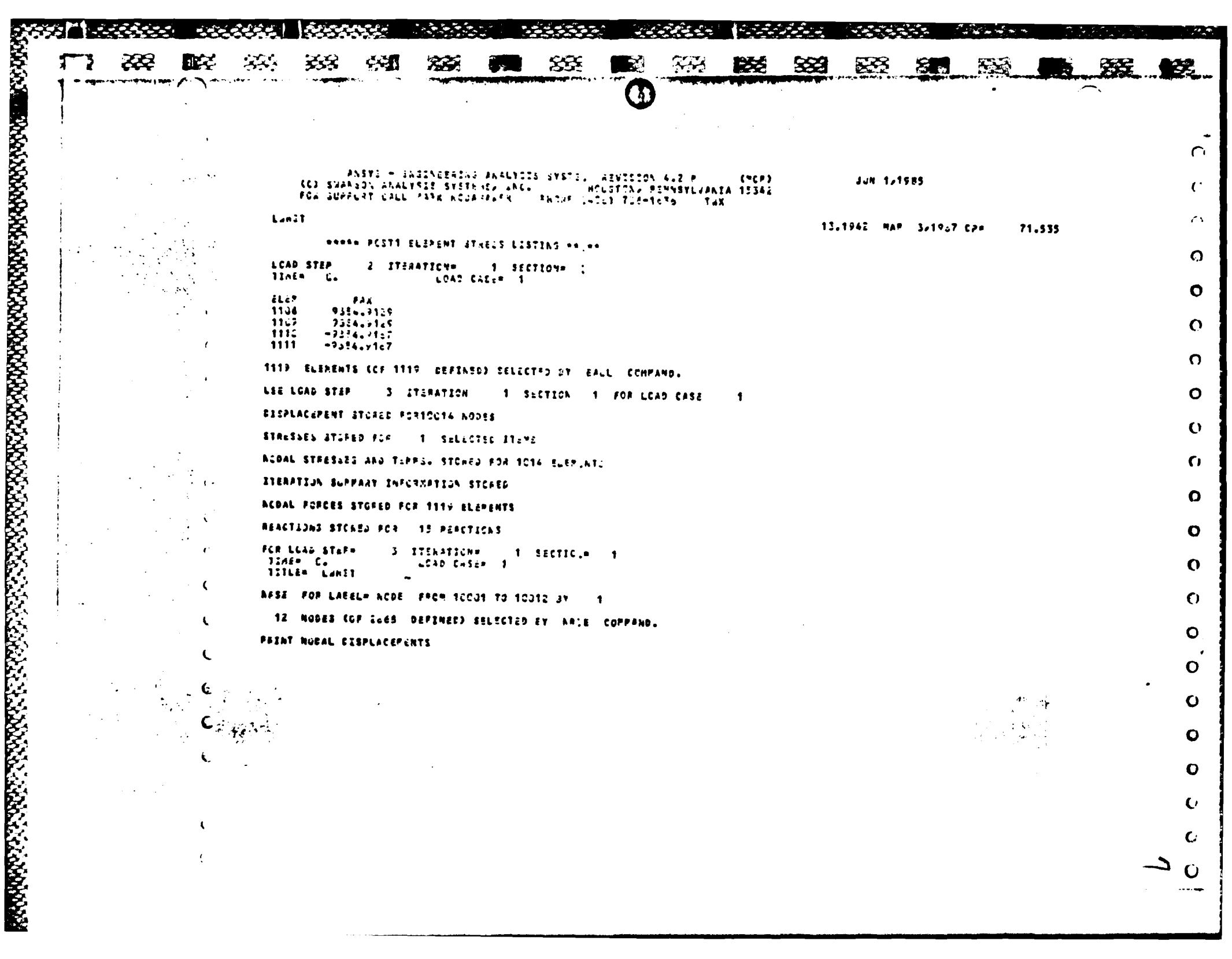
   NODE        UX              UY              UZ              ROTX            ROTY            ROTZ
  10001   -1.C19CC76      -0.0C729212     0.                0.14559590E-05 -C.41C96617E-02  C.39403867E-01
  10006   -0.9E8E4CE9     -0.0C6F35D5C9E-03  0.             C.14559590E-05 -C.41J9e4C9E-02  C.39403P67E-01
  10003   -0.9C2C35E3     -0.0C7E7J0E13E-02  0.             0.19095512E-05 -C.40990671E-02  C.393579e4E-01
  10004   -0.0C6F2E7C4    -0.1117F1C3E-02  0.               0.19961715E-05 -0.39895519E-02  C.39e75013E-01
  10005   -0.8481E3E0E-01 -0.9E97E4130E-06  0.              0.11590395E-05 -0.402748J6E-02  0.379926e7E-01
  10006   -0.0EC54C1ECE-01 -0.9C11U6934E-04  0.             C.11169245E-05 -C.40339253E-02  0.379505B3E-01
  10007   0.                0.              0.             -0.53779531E-02  0.             0.33C22440E-01
  10008   0.14e836e32-01  0.9C8E5941       0.772,e1C8E-01 -0.41C3795?E-02 -0.92743938E-02  0.35C15143E-01
  10009   -0.2C4E6636     0.9Cc74c71       C.1C4;14,9     -0.2P1164361E-03 -C.4947c7e7E-02  C.393764C8E-01
  10010   0.              0.              0.             C.53219C19E-02  C.             C.33C20653E-01
  10011   0.14e35:C4e-01  -0.0C923A5C     -0.793,,0E37E-01 C.41C94198E-02 -C.92746141E-02  C.35C13435E-01
  10012   -0.2C491C0C     -0.9C729212     -0.1C4;C927     0.275972?9E-03 -C.e4512359E-02  0.39379980E-01

 PRINPLNS
 NODE      10CC1          10C12          10C1.          10010          10011          100C1
 VALUE    -1.C19CC76     -C.9C729212    -C.1C4;C927     0.5?819C18E-C2 -C.9274e141E-C2  C.39403867E-01

 ESS=  FOR LABEL= STIF  PROP=     4 TO     4 BY    1

    4  ELEMENTS (OF 1115  DEFINED) SELECTED BY  ESEL  COMMAND.

 PRINT ELEMENT STRESS ITEMS PER ELEMENT
```



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          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 P        (MCP)          JUN 1,1985
    (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL PARK NODAMAKER    PHONE (412) 734-1676    TWX

LWHIT                                                                    13.1942  MAR  3,1987 CP=     71.535

        ***** POST1 ELEMENT STRESS LISTING ****

LOAD STEP     2  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        PAX
1108     9354.9129
1109     9354.9129
1110    -9354.9167
1111    -9354.9167

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

USE LOAD STEP     3  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR10014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     3  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHIT

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2665  DEFINED) SELECTED BY  NASE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

7

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                ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B        (PCP)          JUN 1,1995
      (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
      FOR SUPPORT CALL "ATA HOUR-RATE"    PHONE (412) 746-3304    TWX

 LGHST                                                                  13.2131  MAR  3,1987 CP=      94.735

          ***** POST1 NODAL DISPLACEMENT LISTING *****

 LOAD STEP     3  ITERATION=     1  SECTION=  1
 TIME=   0.              LOAD CASE=  1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

   NODE        UX              UY              UZ              ROTX            ROTY            ROTZ
  10001  -0.11723e-04     -1.5140629      0.              0.39439821E-02 -0.47340571E-03  0.46832732E-02
  10002  -0.60534032E-01  -0.3845416      0.              0.35107823E-02 -0.47340571E-03  0.46232732E-02
  10003  -0.57e772E-01    -0.3613677      0.              0.34925253E-02 -0.47140351E-03  0.46840079E-02
  10004  -0.35e355E2E-01  -0.36777749     0.              0.36996404E-02 -0.451367c1E-03  0.4722e524E-02
  10005  -0.10271373E-01   0.7e7.0C96E-01 0.              0.36845914E-02 -0.46073266E-03  0.47c03969E-02
  10006  -0.74d7oC46E-02   0.13905356     0.              0.36e56496E-02 -0.44212153E-03  0.47e441e0E-02
  10007   0.               0.             0.              0.45460365E-02  0.              0.37C61158E-02
  10008  -0.11C3e5C7E-01  -0.37447318     -0.5317945?E-01  0.19431634E-02 -0.11760EC3E-02  0.40152151E-02
  10009  -0.2899e514E-01  -0.7Ce91C75     -0.9Ce.37JCE-01  0.51e44640E-02 -0.12487362E-03  0.47122499E-02
  10010   0.               0.             0.              0.59275964E-02  0.              0.41238EC9E-02
  10011   0.1CC94e7E-01    -0.5193c813    -0.719;04?7E-01  0.21193753E-02 -0.1CC19C25E-02  0.42e25C64E-02
  10012  -0.22C296?5E-01  -0.92190573     -0.123;0204      0.32126706E-02 -0.1C389495E-02  0.46C92175E-02

 PARAMETERS
 NODE       10CC1           10Cc1           10C1,           10CC1           10CC8           10C6
 VALUE   -0.11723644     -1.5140629      -0.123;0204      0.39439821E-02 -0.11760E03E-02  0.476441e0E-02

 ERASE  FOR LABEL= STEP  FROM     4 TO     4 BY     1

    4  ELEMENTS (OF 1119  DEFINED) SELECTED BY  ERSE  COMMAND.

 PRINT ELEMENT STRESS ITEMS PER ELEMENT
```

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          ANSYS - ENGINEERING ANALYSIS SYSTEM, REVISION 4.2 P        (MCP)          JUN 1,1985
    (C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
    FOR SUPPORT CALL MARK ROLAHAMER    PHONE (403) 736-1636    TWX

LWHST                                                                    13.2136  MAR  3,1987 CP=     95.932

        ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP     3  ITERATION=     1  SECTION=  1
TIME=   0.                LOAD CASE=  1

ELEM        FAX
1108    -4210.5594
1109    -4206.5110
1110    -6496.4317
1111    -6494.1004

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  EALL  COMMAND.

USE LOAD STEP     4  ITERATION     1  SECTION   1  FOR LOAD CASE     1

DISPLACEMENT STORED FOR10014 NODES

STRESSES STORED FOR    1  SELECTED ITEMS

NODAL STRESSES AND TEMPS. STORED FOR 1014 ELEMENTS

ITERATION SUMMARY INFORMATION STORED

NODAL FORCES STORED FOR 1119 ELEMENTS

REACTIONS STORED FOR   15 REACTIONS

FOR LOAD STEP=     4  ITERATION=     1  SECTION=   1
 TIME=  0.              LOAD CASE=  1
 TITLE=  LWHST

NASE  FOR LABEL= NODE  FROM 10001 TO 10012 BY    1

  12  NODES (OF 2668  DEFINED) SELECTED BY  NRCE  COMMAND.

PRINT NODAL DISPLACEMENTS
```

9

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                ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 B      (MCR)          JUN 1,1985
      (C) SWANSON ANALYSIS SYSTEMS, INC.          HOUSTON, PENNSYLVANIA 15342
      FOR SUPPORT CALL MARK SWANSON     PHONE (412) 746-3304    TWX

 LUMST                                                                  12.2419  MAX  3.1987 CPU    119.301

          ***** POST1 NODAL DISPLACEMENT LISTING *****

 LOAD STEP     4  ITERATION=     1  SUBSTEP=     1
 TIME=   0.              LOAD CASE=   1

 THE FOLLOWING X,Y,Z DISPLACEMENTS ARE IN NODAL COORDINATES

   NODE       UX              UY              UZ              ROTX            ROTY            ROTZ
  10001  -1.0211273      -5.9456133      0.              0.19241297E-01 -0.41105140E-02 0.39427645E-01
  10002  -0.8827[illegible]      -[illegible]      0.              0.18926697E-01 -0.41105140E-02 0.39427645E-01
  10003  -0.7[illegible]      -[illegible]      0.              0.19660[illegible]E-01 -0.4[illegible]E-02 0.39[illegible]E-01
  10004  -0.[illegible]      -[illegible]      0.              0.19[illegible]E-01 -0.[illegible]E-02 0.39[illegible]E-01
  10005  -0.[illegible]      -[illegible]      0.              0.19[illegible]E-01 -0.[illegible]E-02 0.38[illegible]E-01
  10006  -0.[illegible]      -[illegible]      0.              0.19[illegible]E-01 -0.[illegible]E-02 0.37[illegible]E-01
  10007  0.              0.              0.              0.11[illegible]E-01  0.              0.32[illegible]E-01
  10008  -0.[illegible]      -[illegible]      -[illegible]      0.56[illegible]E-02 -0.95278222E-02 0.34[illegible]E-01
  10009  -0.[illegible]      -[illegible]      -[illegible]      0.19[illegible]E-01 -0.[illegible]E-02 0.39[illegible]E-01
  10010  0.              0.              0.              0.21779383E-01  0.              0.33[illegible]E-01
  10011  0.[illegible]      -[illegible]      -[illegible]      0.16[illegible]E-01 -0.[illegible]E-02 0.33[illegible]E-01
  10012  -0.[illegible]      -[illegible]      -[illegible]      0.19[illegible]E-01 -0.[illegible]E-02 0.39[illegible]E-01

 MAXIMUMS
 NODE      10001           10001           10011           10010           10008           10009
 VALUE    -1.0211273      -5.9456133      -0.61570633      0.21779383E-01 -0.95278222E-02  0.39584612E-01

 BASE  FOR LABEL= STEP  FROM     4 TO     4 BY     1

   * ELEMENTS (OF 1119  DEFINED) SELECTED BY  ESEL  COMMAND.

 PRINT ELEMENT STRESS STEPS PER ELEMENT
```

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ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.2 =        (MCR)          JUN 1,1985
(C) SWANSON ANALYSIS SYSTEMS, INC.        HOUSTON, PENNSYLVANIA 15342
FOR SUPPORT CALL MARK MCDAMAKER    PHONE (405) 726-1636    TWX
LWHST                                                                  13.2439  MAR  3,1987 CP=    120.544

      ***** POST1 ELEMENT STRESS LISTING *****

LOAD STEP     4  ITERATION=     1  SECTION=  1
TIME=   0.              LOAD CASE=  1

ELEM        MAX
1108    -3828.3311
1109    -9825.9820
1110    -27592.736
1111    -27590.400

1119  ELEMENTS (OF 1119  DEFINED) SELECTED BY  BALL  COMMAND.

***** ROUTINE COMPLETED *****  CP =        120.749

/EOF ENCOUNTERED ON FILE15

***** RUN COMPLETED *****  CP=       121.0010   TIME=   13.7493
```

D2/340

MCR MEMO: MARCH 3, 1987

MCR
ASSOCIATES, INC.

111 W. Evelyn Ave., Suite 301
Sunnyvale, California 94086
(408) 736-1636

2

March 3, 1987

Larry Libhardt
FMC CORPORATION
3989 Central Ave NE
Minneapolis, Minn 55421

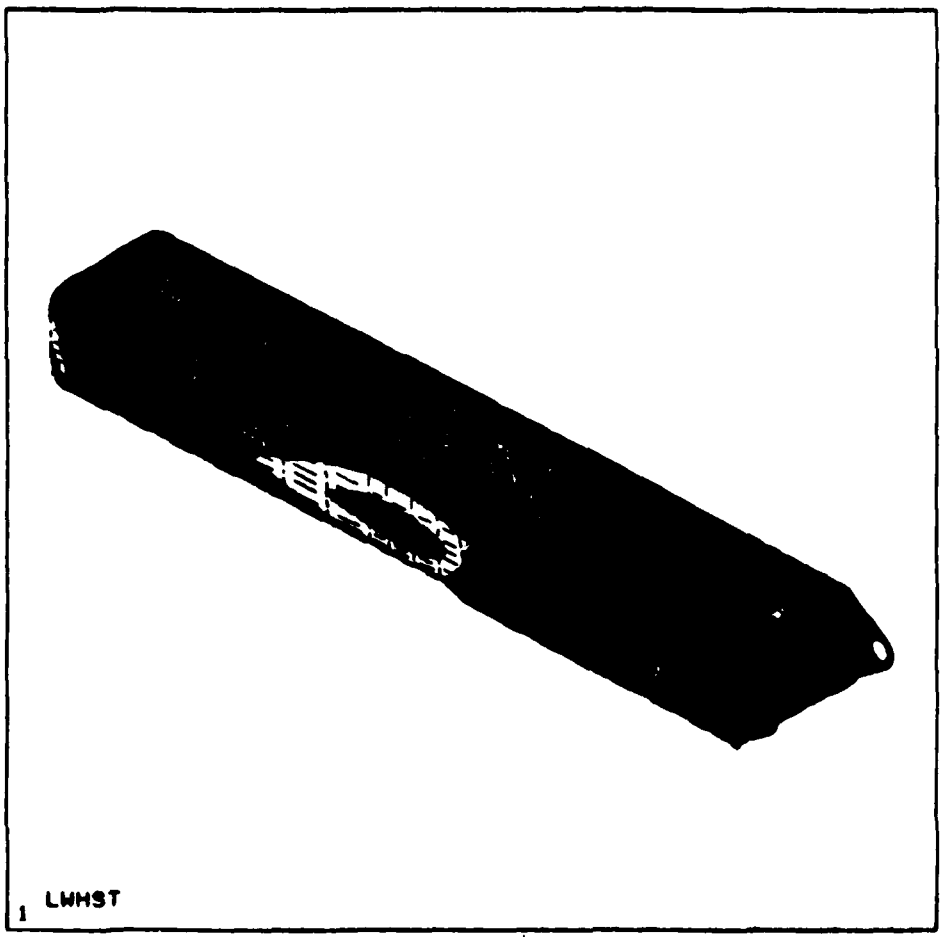
Dear Larry,

I found one slight error in the coupling equations that were used in the previous run. One of the nodes around the periphery should have been listed as 1322 and was actually coded as 1332. This would explain the high stresses noted around the periphery of the front of the shell. Enclosed are the stress contour plots with distorted geometry contour plots for this last case. The actual printout will follow later. I would expect the results 6 to 8 inches behind the shell would be fairly close to reality. The printout for this case will follow in a few days.

Best regards,

Mark C Rodamaker

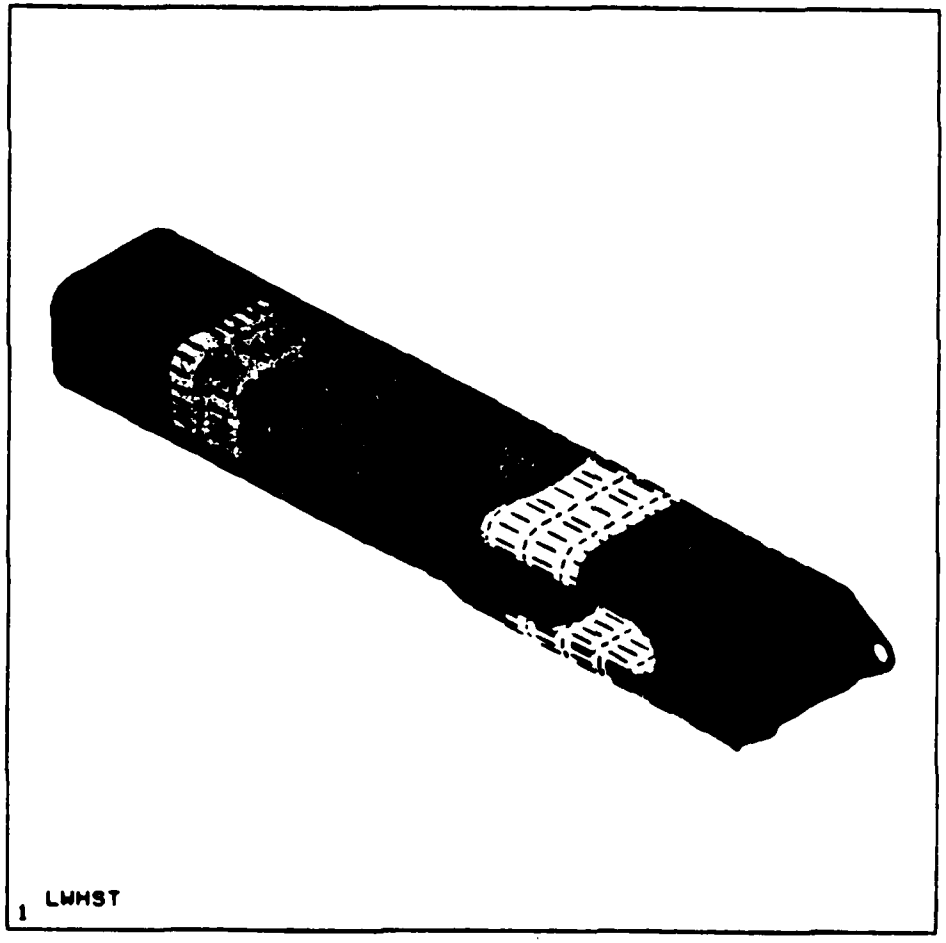
Mark C. Rodamaker



ANSYS 4.2B
MAR 3 1987
11:34:35
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
UX
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0969
MN=-.102
-.0829
-.0599
-.0369
-.0139
.0091

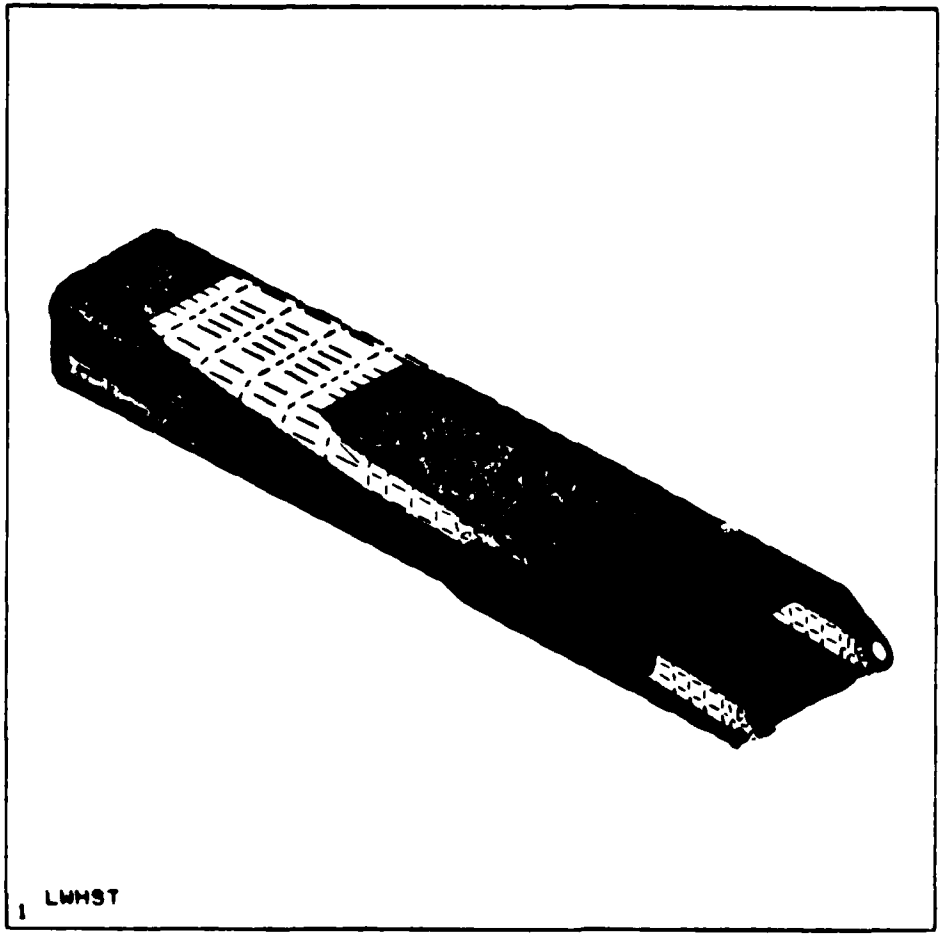
.0781



ANSYS 4.2B
MAR 3 1987
11:35:57
PLOT NO. 2
POST1 STRESS
STEP=1
ITER=1
UY
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0312
MN=-1.9
-1.7
-1.48
-1.26
-1.04
-.822

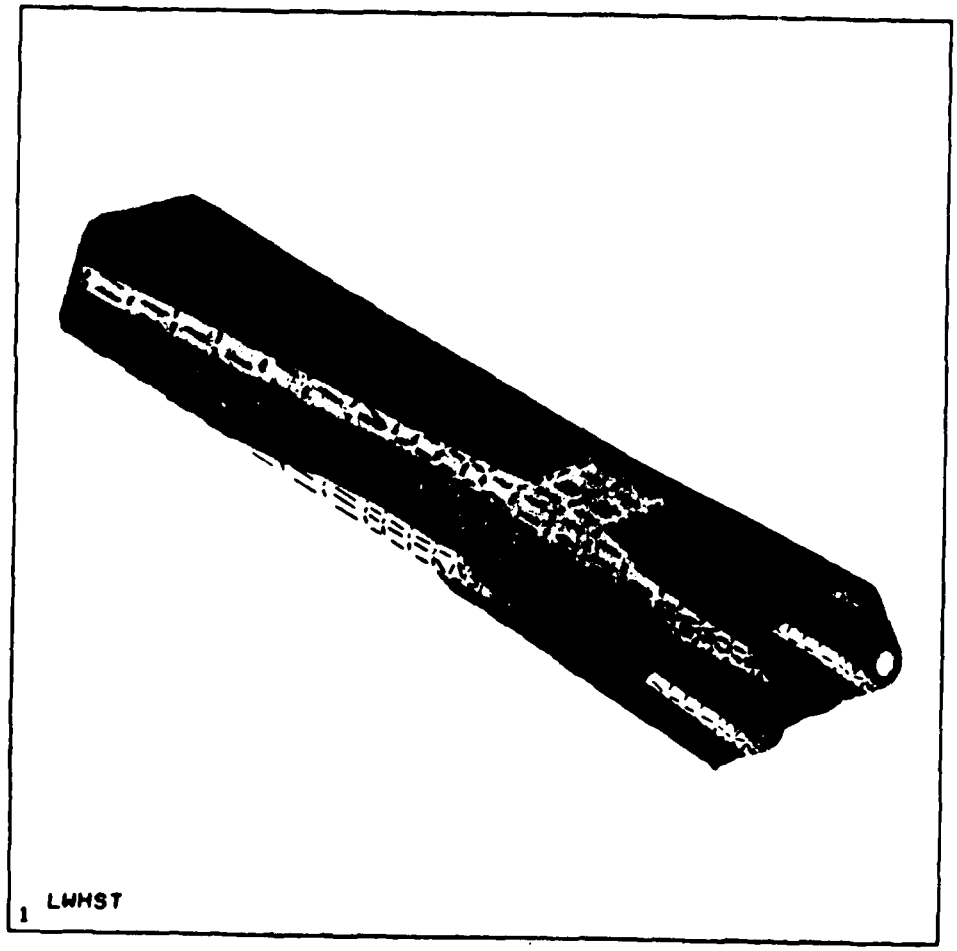
-.162

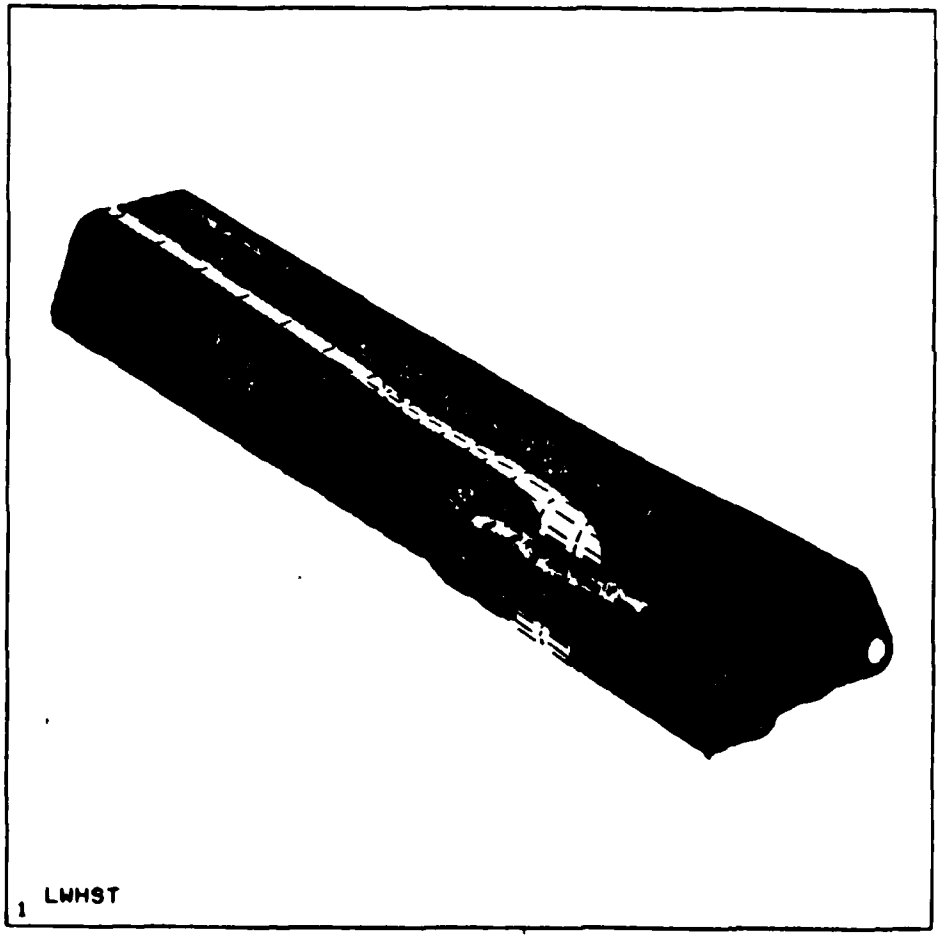


ANSYS 4.2B
MAR 3 1987
11:36:52
PLOT NO. 3
POST1 STRESS
STEP=1
ITER=1
UZ
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0875
MN=-.376
-.354
-.294
-.234
-.174
-.114

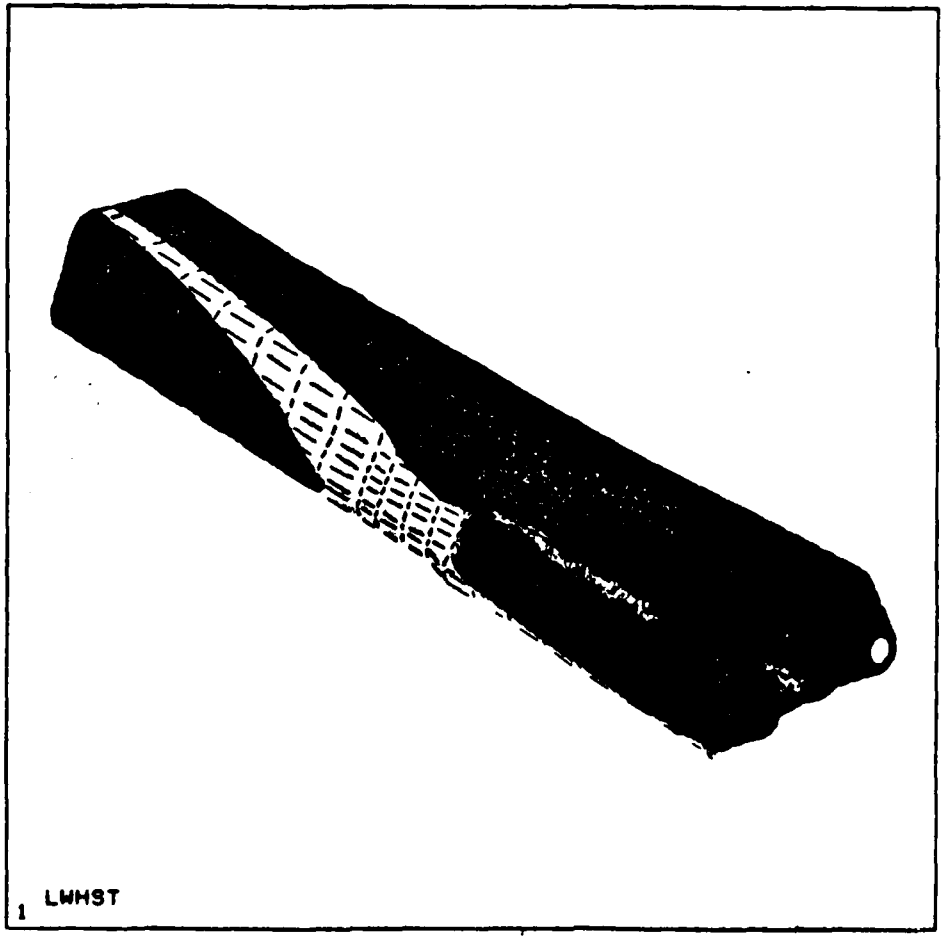
.0655


1 LWHST
ANSYS 4.2B
MAR 3 1987
11:39:08
PLOT NO. 4
POST1 STRESS
STEP=2
ITER=1
UX
DISPL NODAL
XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.693
MN=-.913
-.81
-.61
-.41
-.21
-.0101
.59



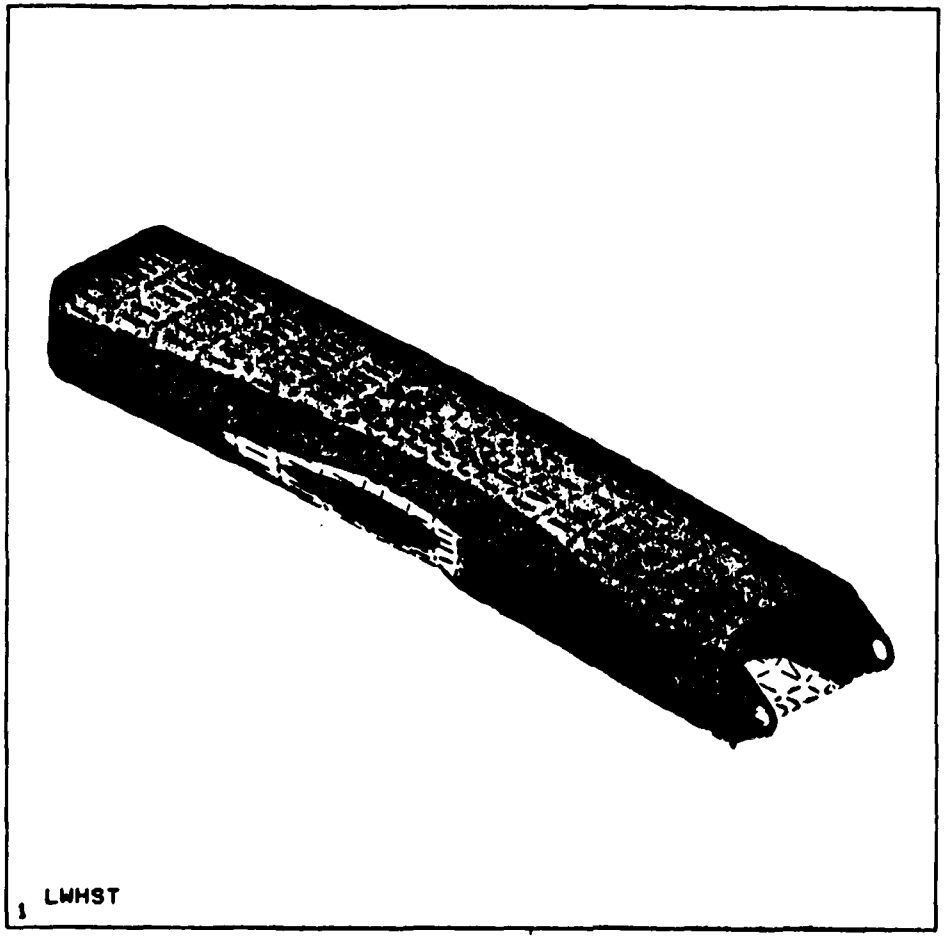
ANSYS 4.2B
MAR 3 1987
11:40:14
PLOT NO. 5
POST1 STRESS
STEP=2
ITER=1
UY
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.51
MN=-.509
-.419
-.299
-.179
-.0593
.0607
.421



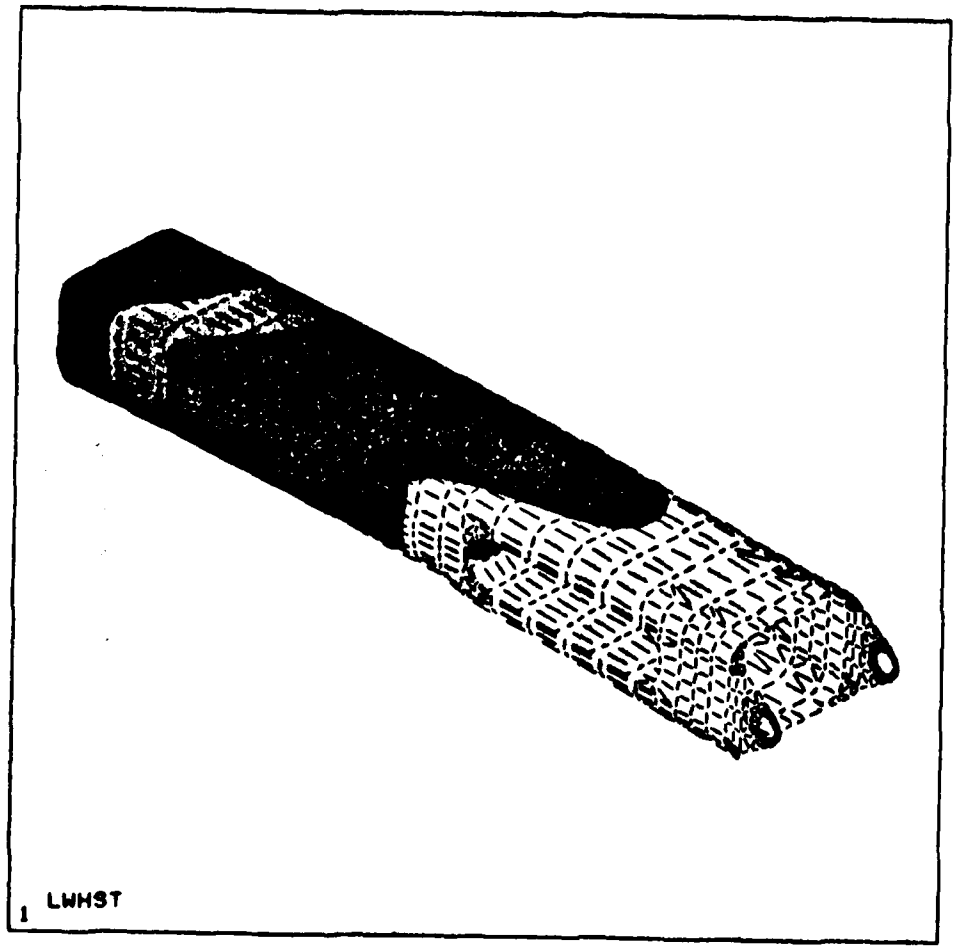
ANSYS 4.2B
MAR 3 1987
11:41:08
PLOT NO. 6
POST1 STRESS
STEP=2
ITER=1
UZ
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0838
MN=-.0839
-.0701
-.0501
-.0301
-.0101
.00995
.0699



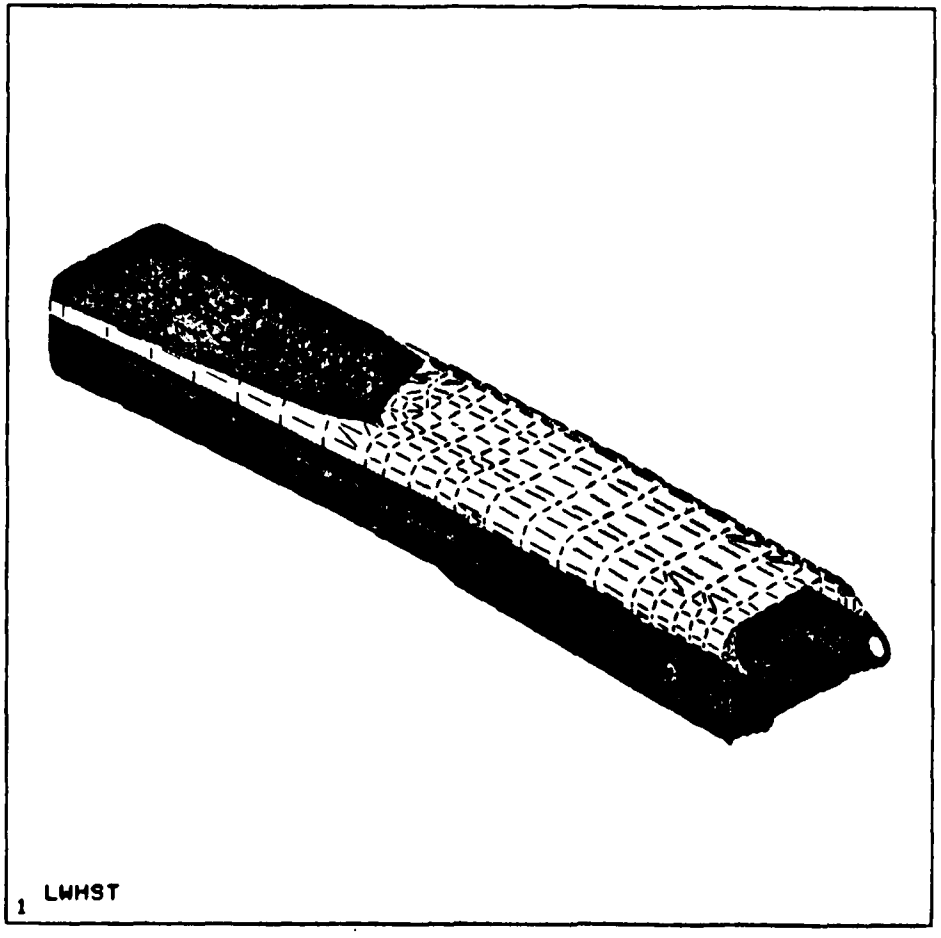
ANSYS 4.2B
MAR 3 1987
11:42:20
PLOT NO. 7
POST1 STRESS
STEP=3
ITER=1
UX
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.188
MN=-.176
-.169
-.119
-.0689
-.0189
.0311
.181



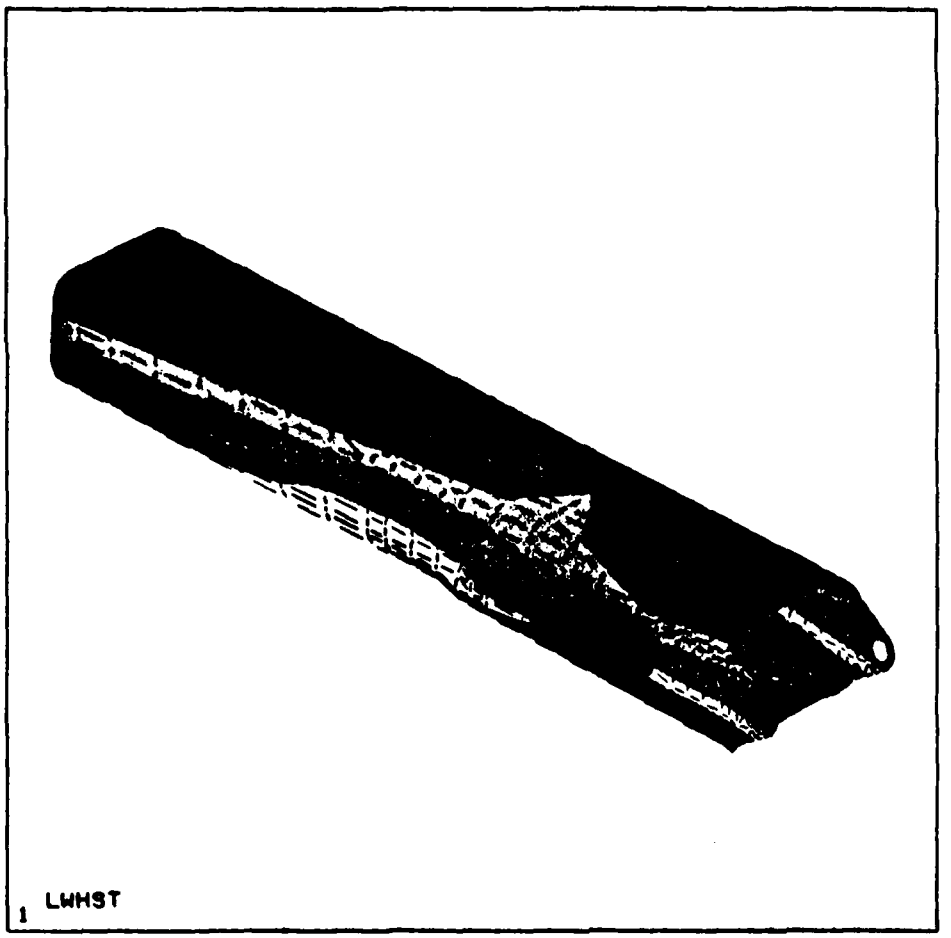
ANSYS 4.2B
MAR 3 1987
11:43:10
PLOT NO. 8
POST1 STRESS
STEP=3
ITER=1
UY
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.288
MN=-.879
-.751
-.621
-.491
-.361
-.231
[illegible]
[illegible]
.159



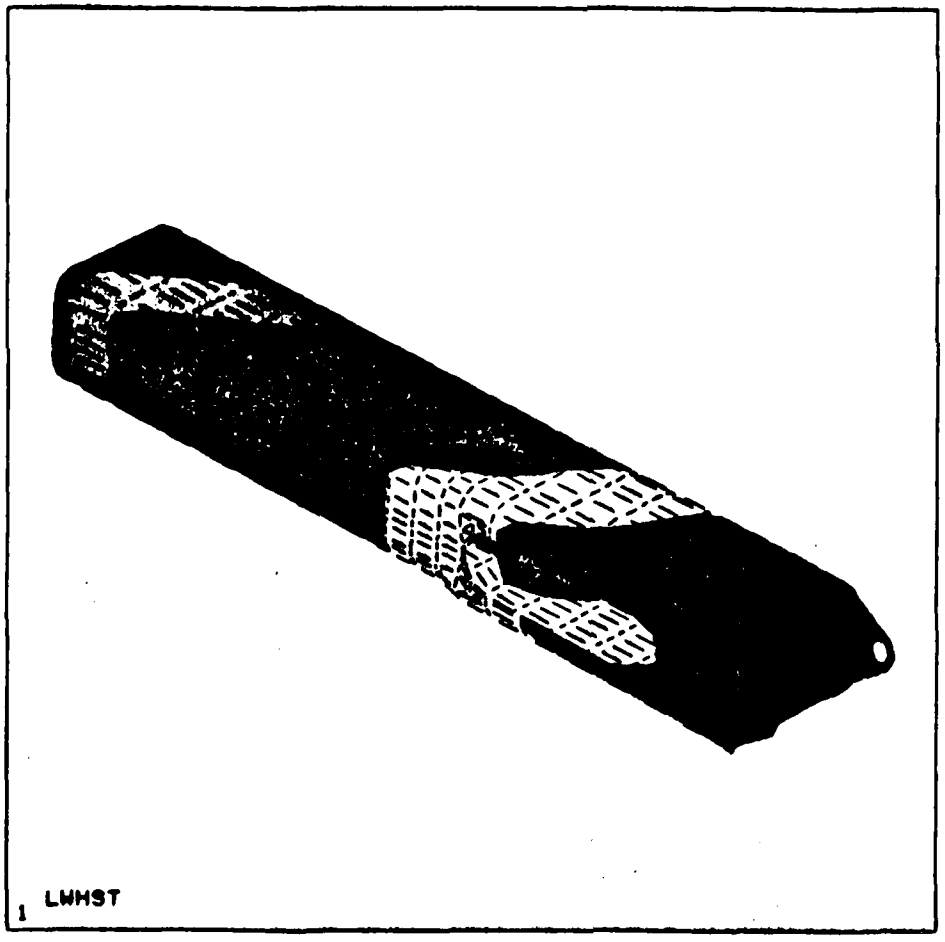
ANSYS 4.2B
MAR 3 1987
11:43:56
PLOT NO. 9
POST1 STRESS
STEP=3
ITER=1
UZ
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0885
MN=-.155
-.138
-.108
-.0782
-.0482
-.0182
.0718



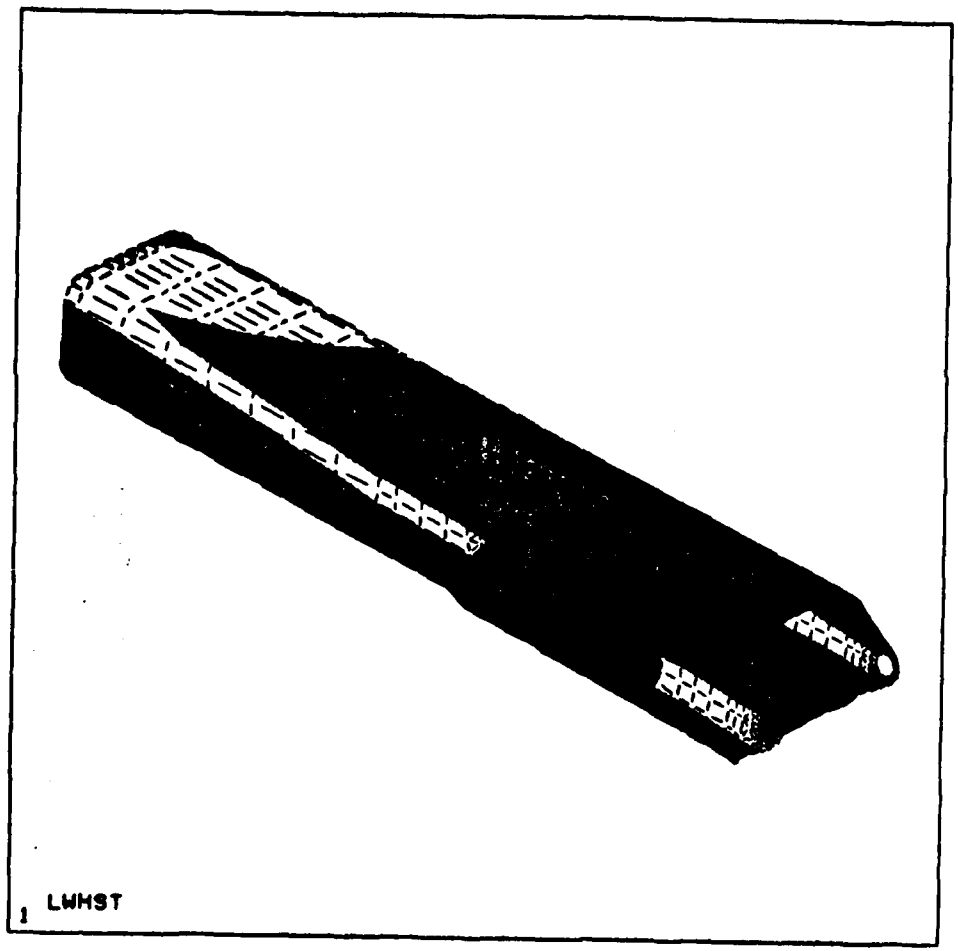
ANSYS 4.2B
MAR 3 1987
11:45:08
PLOT NO. 10
POST1 STRESS
STEP=4
ITER=1
UX
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.711
MN=-.925
-.807
-.607
-.407
-.207
-.00696
[illegible]
[illegible]
.593



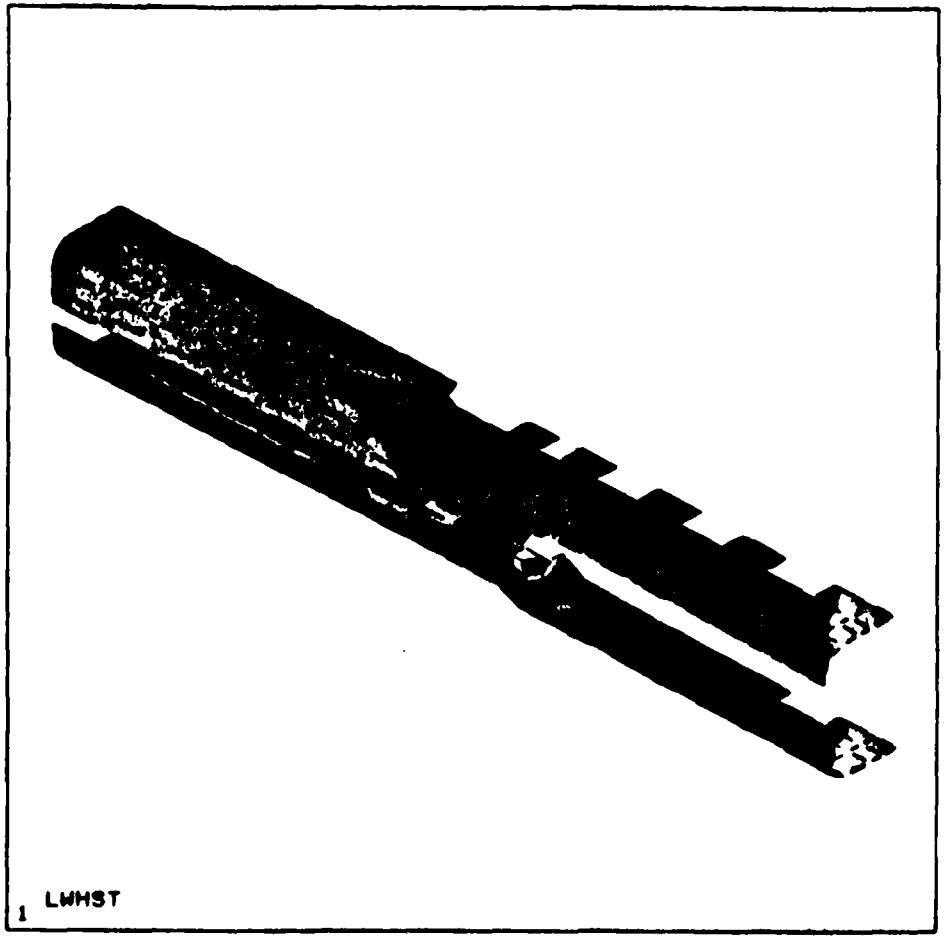
ANSYS 4.2B
MAR 3 1987
11:45:58
PLOT NO. 11
POST1 STRESS
STEP=4
ITER=1
UY
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.0735
MN=-4.13
-3.78
-3.28
-2.78
-2.28
-1.78
-1.28
-.78
-.28



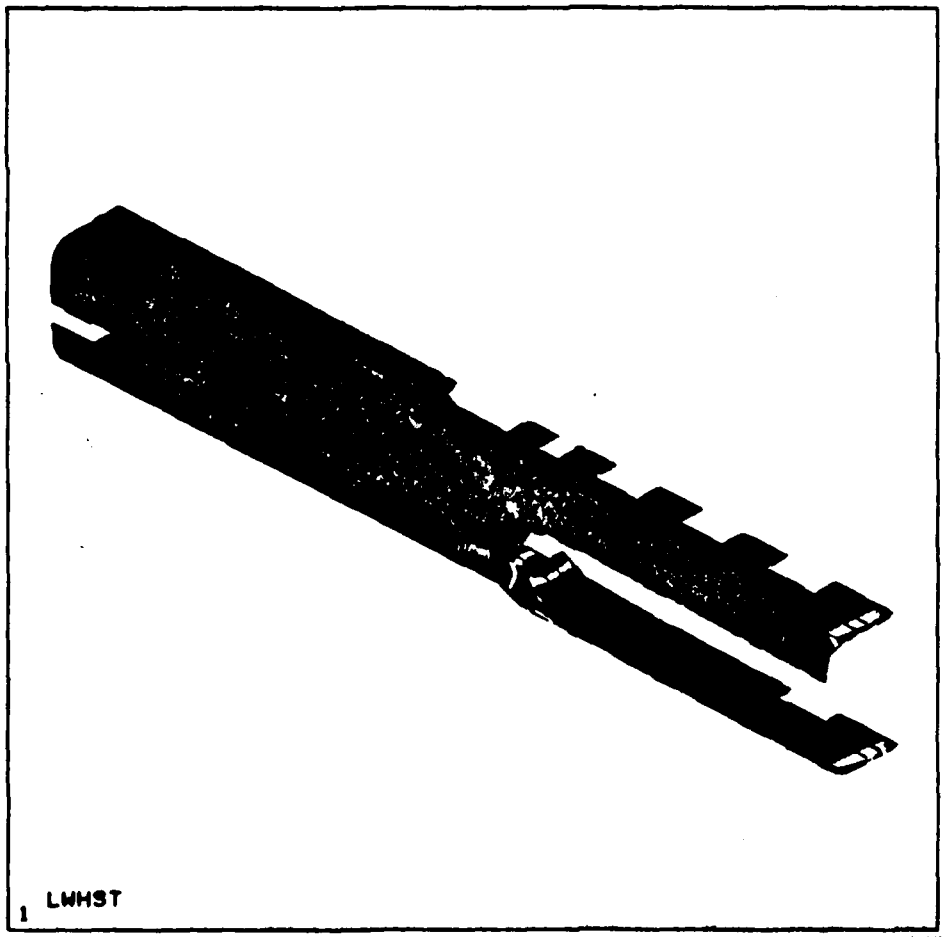
ANSYS 4.2B
MAR 3 1987
11:46:43
PLOT NO. 12
POST1 STRESS
STEP=4
ITER=1
UZ
DISPL NODAL

XV=1
YV=1
ZV=-1
DIST=107
XF=-2.54
YF=1.22
ZF=-116
HIDDEN
MX=.212
MN=-.657
-.572
-.472
-.372
-.272
-.172
.128



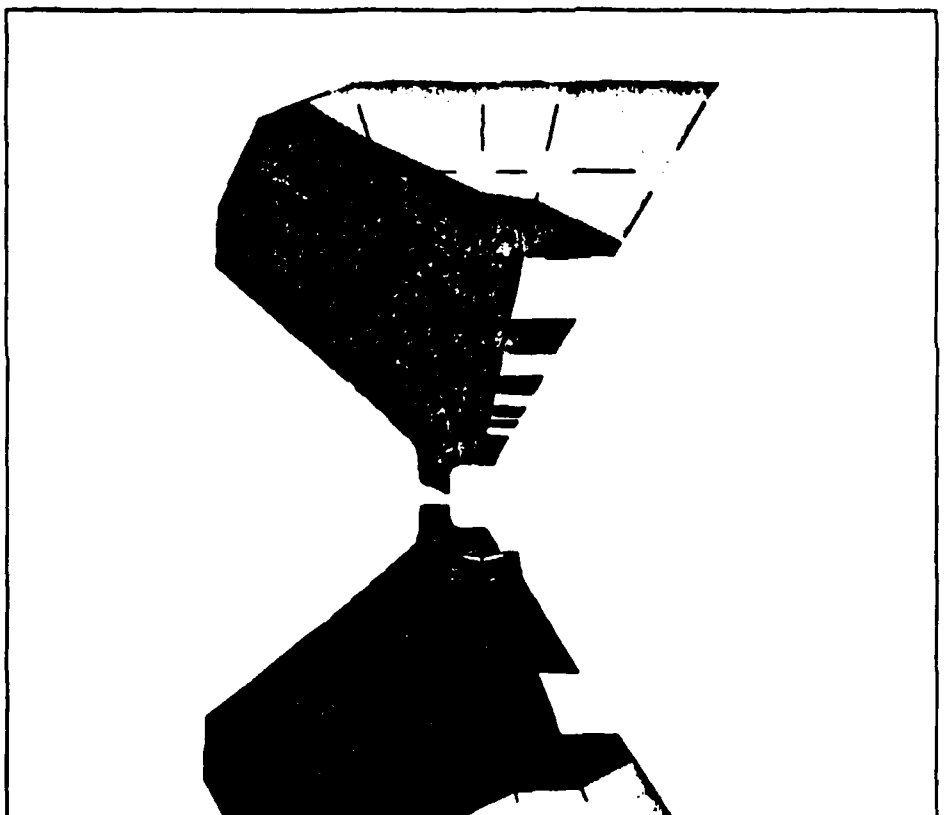
ANSYS 4.2B
MAR 3 1987
7:24:09
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=6210
MN=-13704
-11493
-9280
-7067
-4854
-2641



ANSYS 4.2B
MAR 3 1987
7:24:29
PLOT NO. 2
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

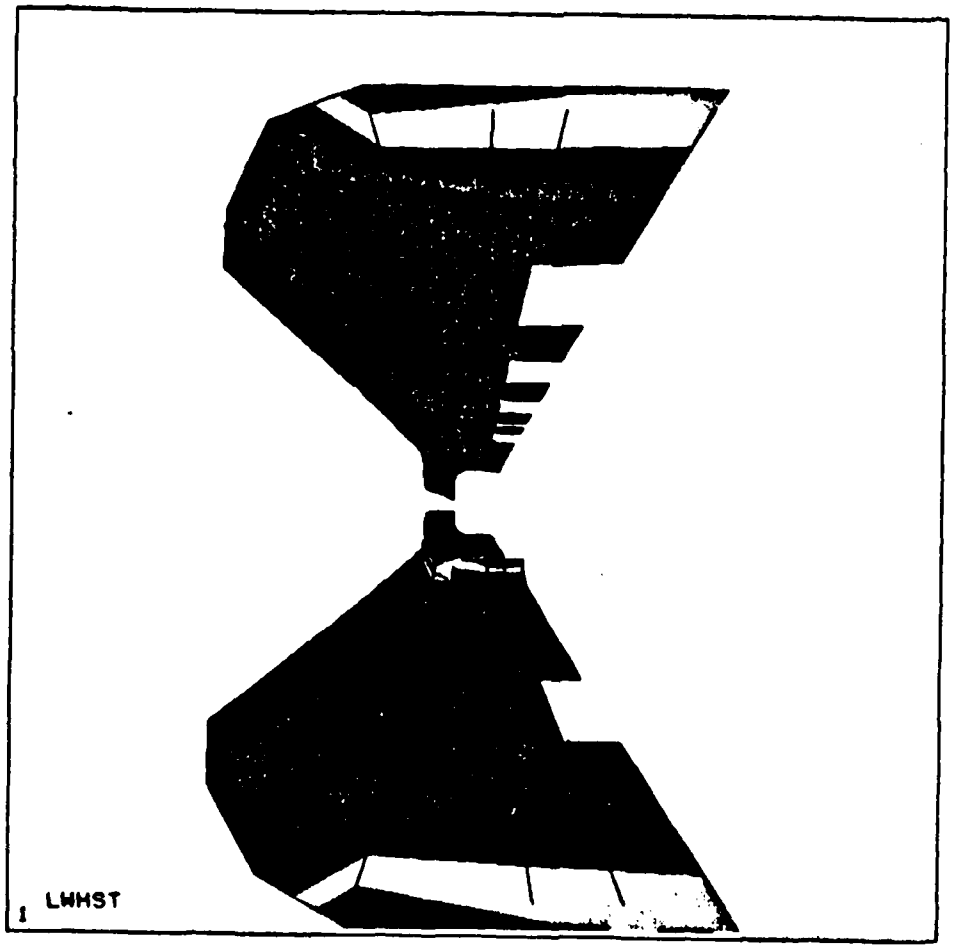
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=6110
MN=-6476
-5080
-3681
-2282
-883
516
1915
3314



ANSYS 4.2B
MAR 3 1987
7:26:42
PLOT NO. 3
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

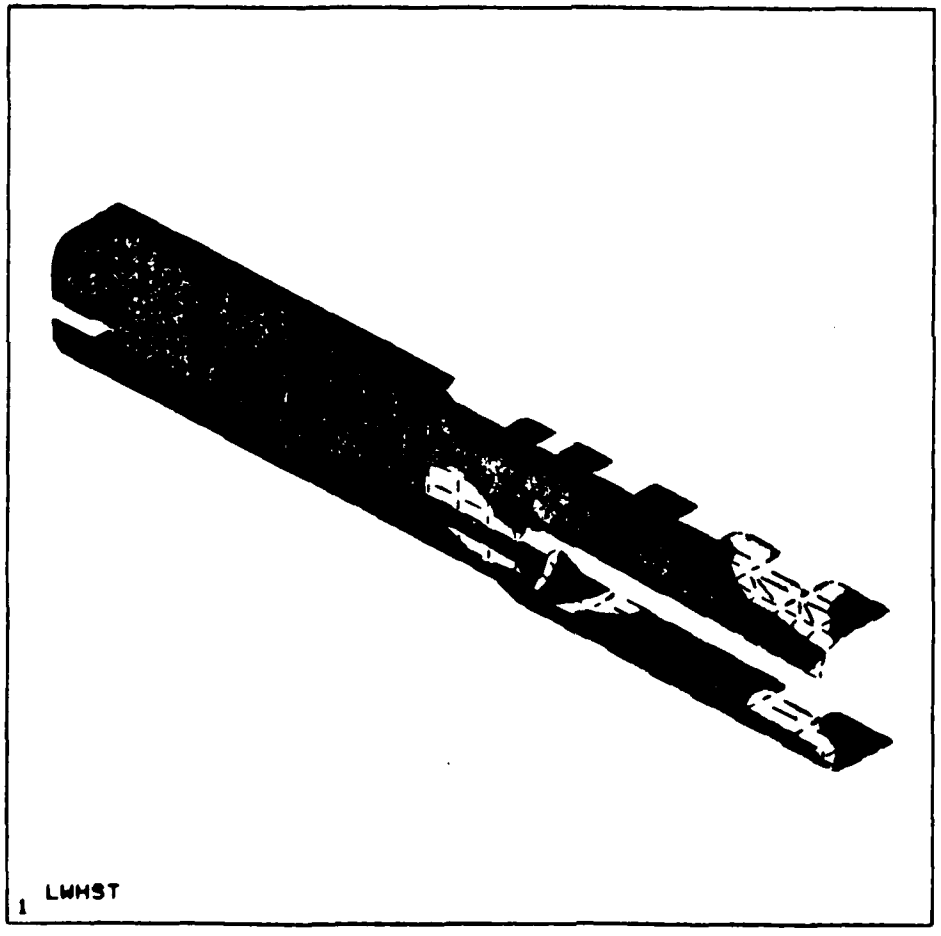
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=6210
MN=-13704
-11493
-9280
-7067
-4854
-2641

3998
6211



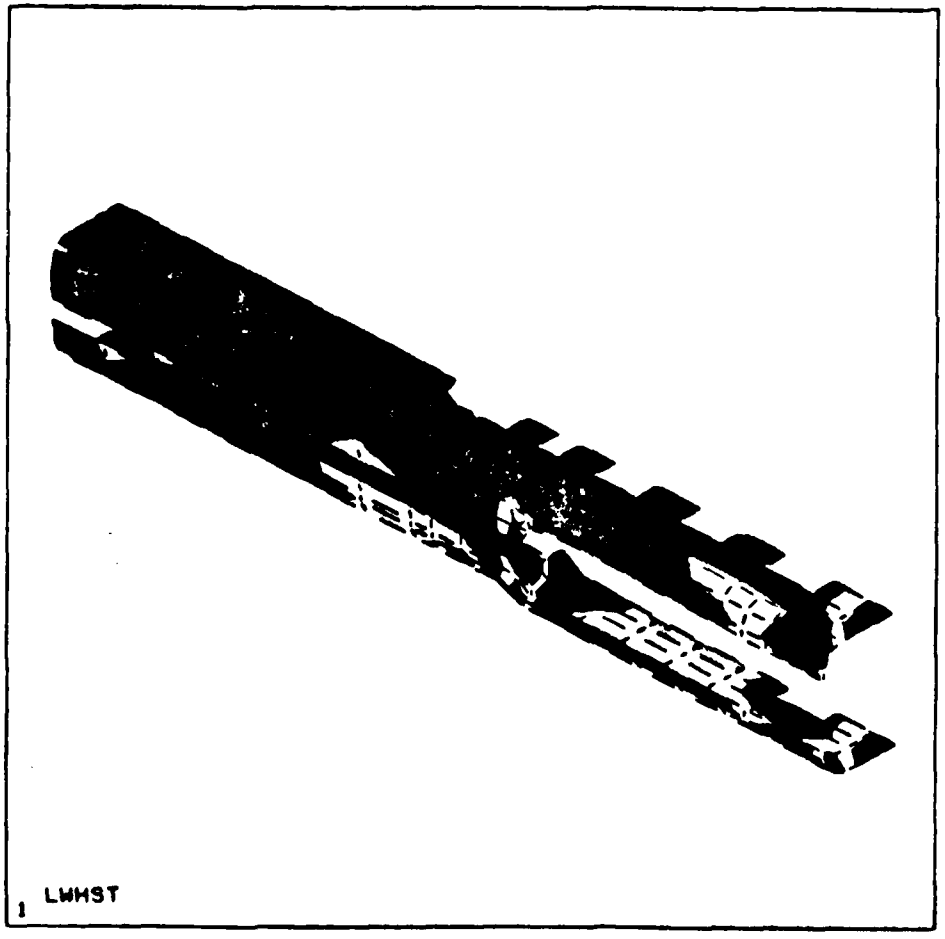
ANSYS 4.2B
MAR 3 1987
7:27:00
PLOT NO. 4
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=6110
MN=-6476
-5080
-3681
-2282
-883
516
1915
3314
4713
6112



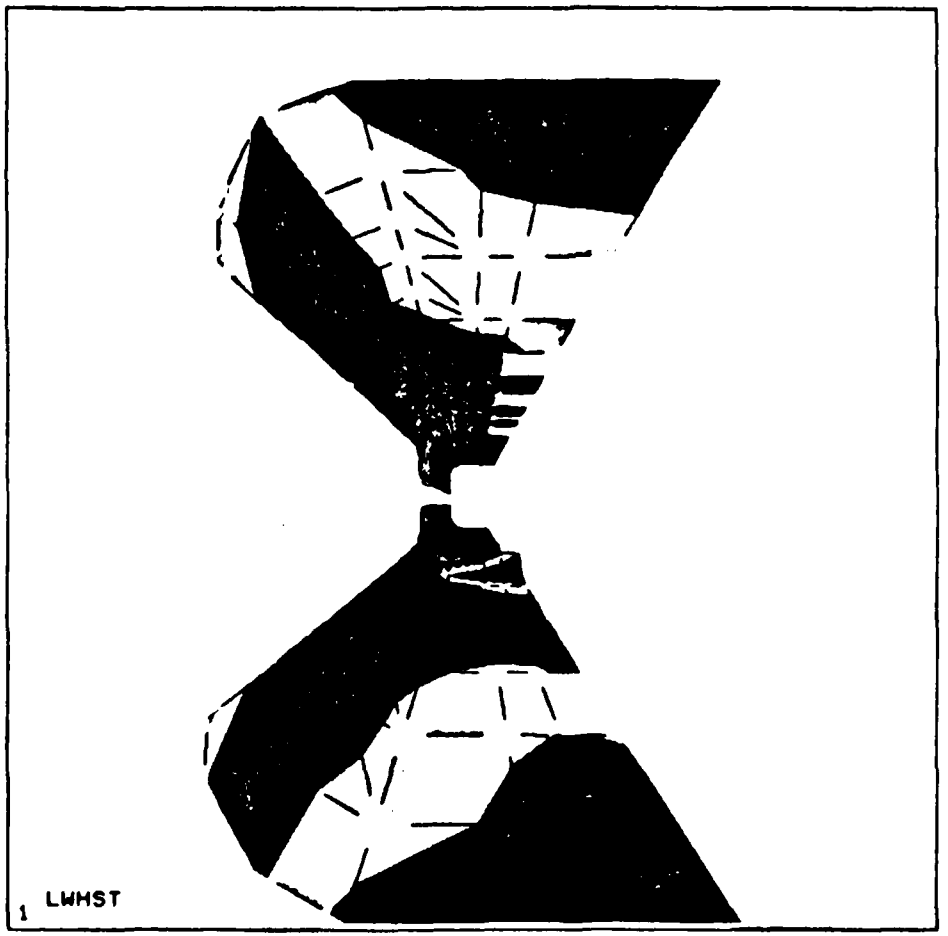
ANSYS 4.2B
MAR 3 1987
7:27:26
PLOT NO. 5
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=4931
MN=-18939
-16290
-13637
-10984
-8331
-5678



ANSYS 4.2B
MAR 3 1987
7:27:42
PLOT NO. 6
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=3772
MN=-6844
-5666
-4486
-3306
-2126
-946



ANSYS 4.2B
MAR 3 1987
7:27:58
PLOT NO. 7
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

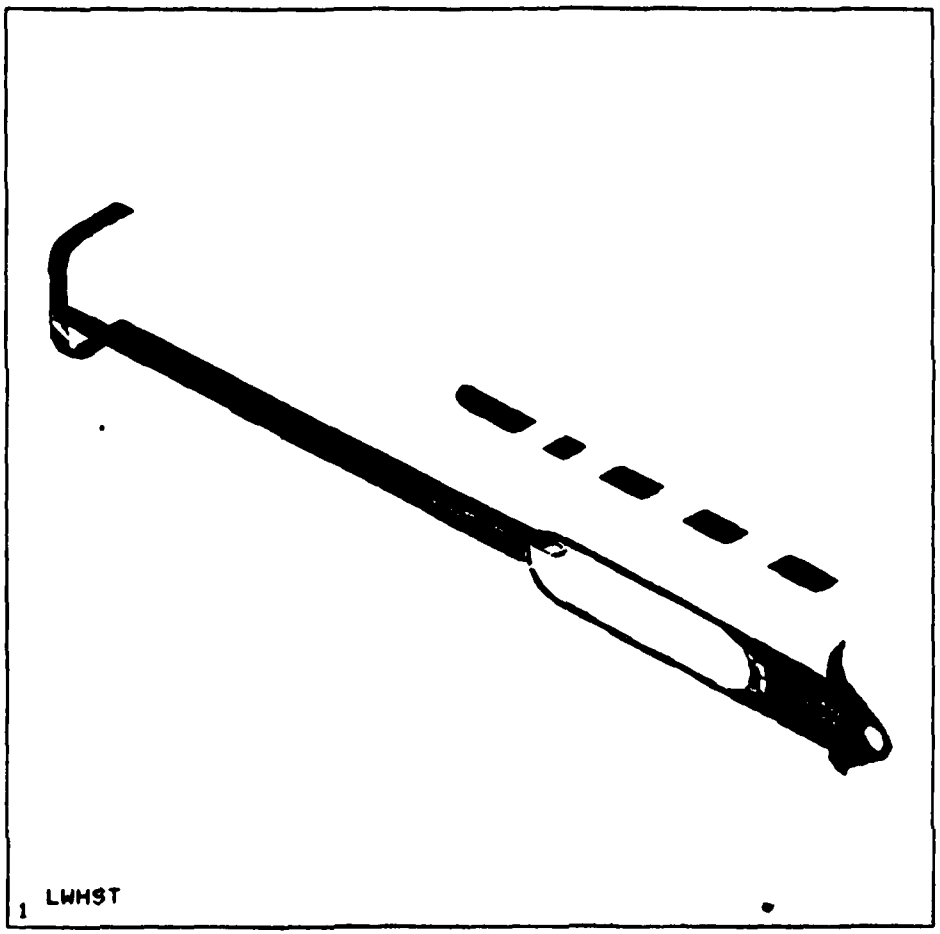
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=4931
MN=-18939
-16290
-13637
-10984
-8331
-5678

2281
4934

ANSYS 4.2B
MAR 3 1987
7:28:13
PLOT NO. 8
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

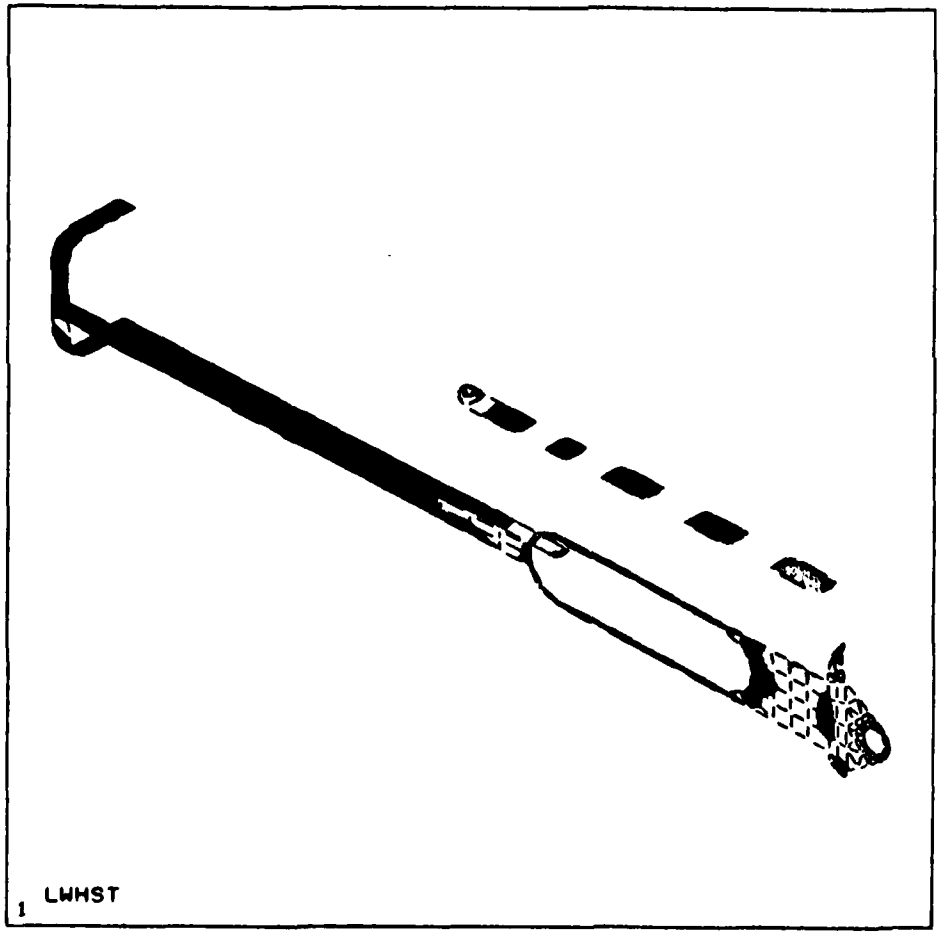
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=3772
MN=-6844
-5666
-4486
-3306
-2126
-946

2594
3774



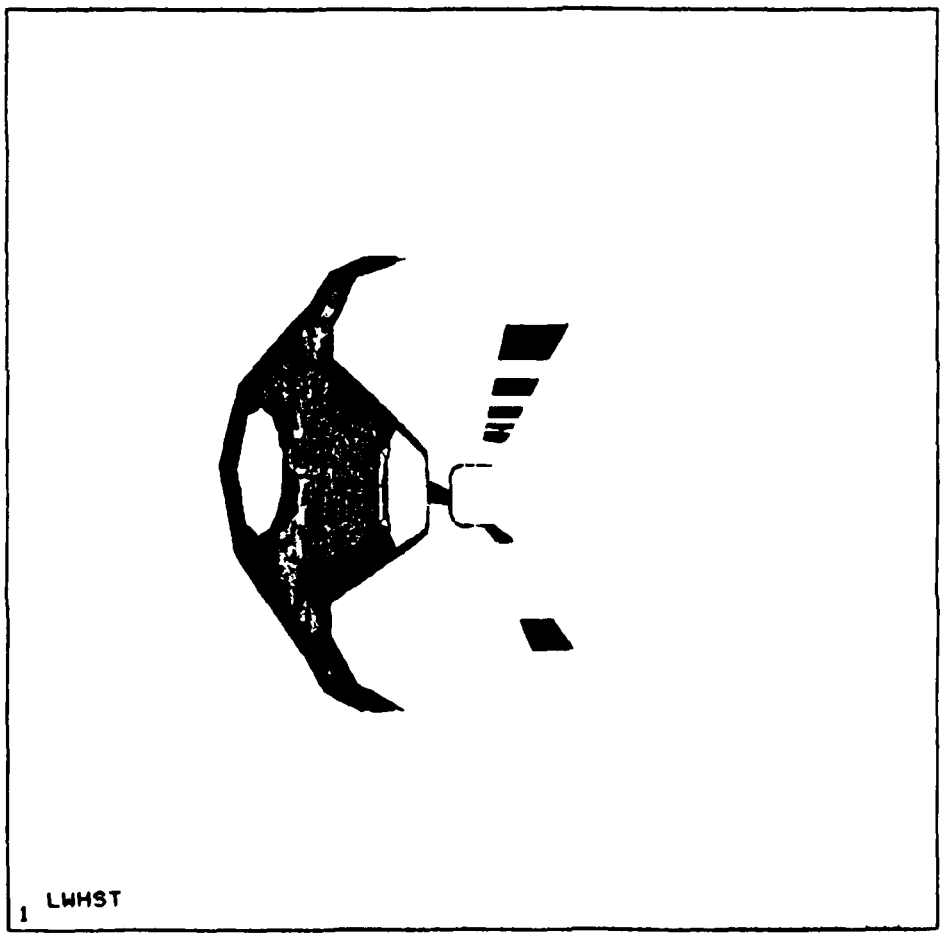
ANSYS 4.2B
MAR 3 1987
7:28:45
PLOT NO. 9
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=7377
MN=-6446
-4911
-3375
-1839
-303
1233



ANSYS 4.2B
MAR 3 1987
7:28:53
PLOT NO. 10
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

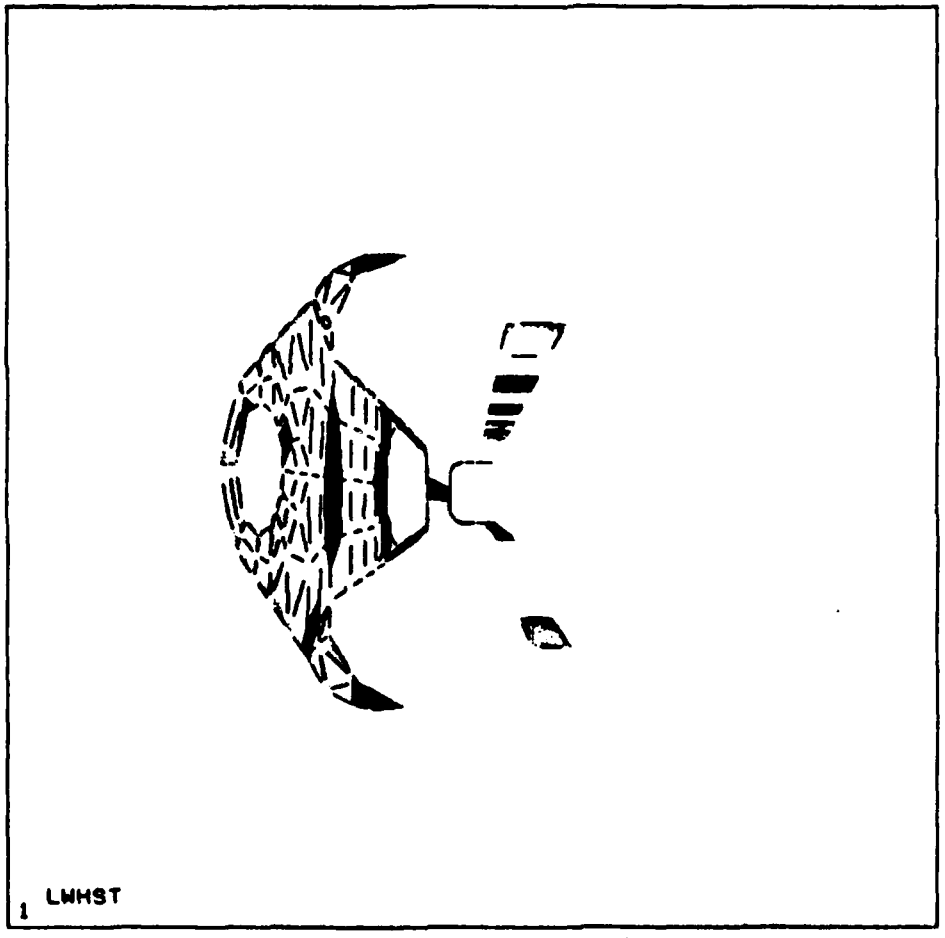
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=7865
MN=-25964
-22206
-18447
-14688
-10929
-7170



ANSYS 4.2B
MAR 3 1987
7:29:03
PLOT NO. 11
POST1 STRESS
STEP=1
ITER=1
SX
TOP
STRESS ELEM CS

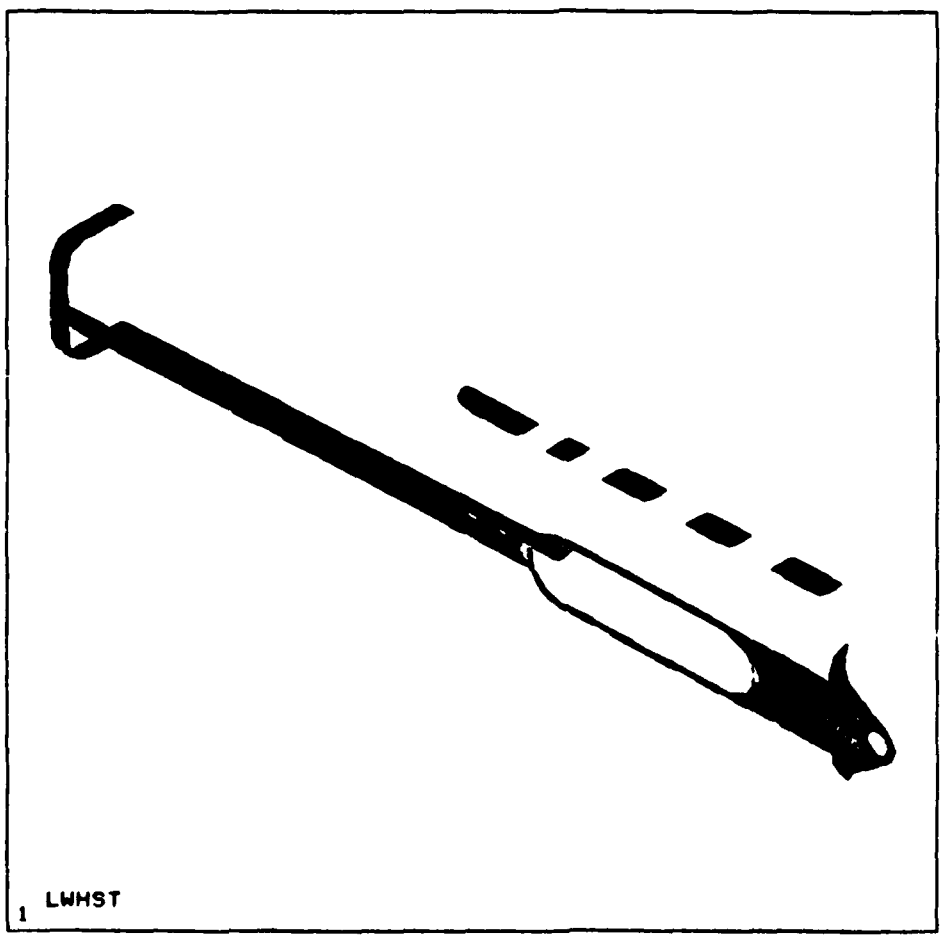
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=7377
MN=-6446
-4911
-3375
-1839
-303
1233

5841
7377



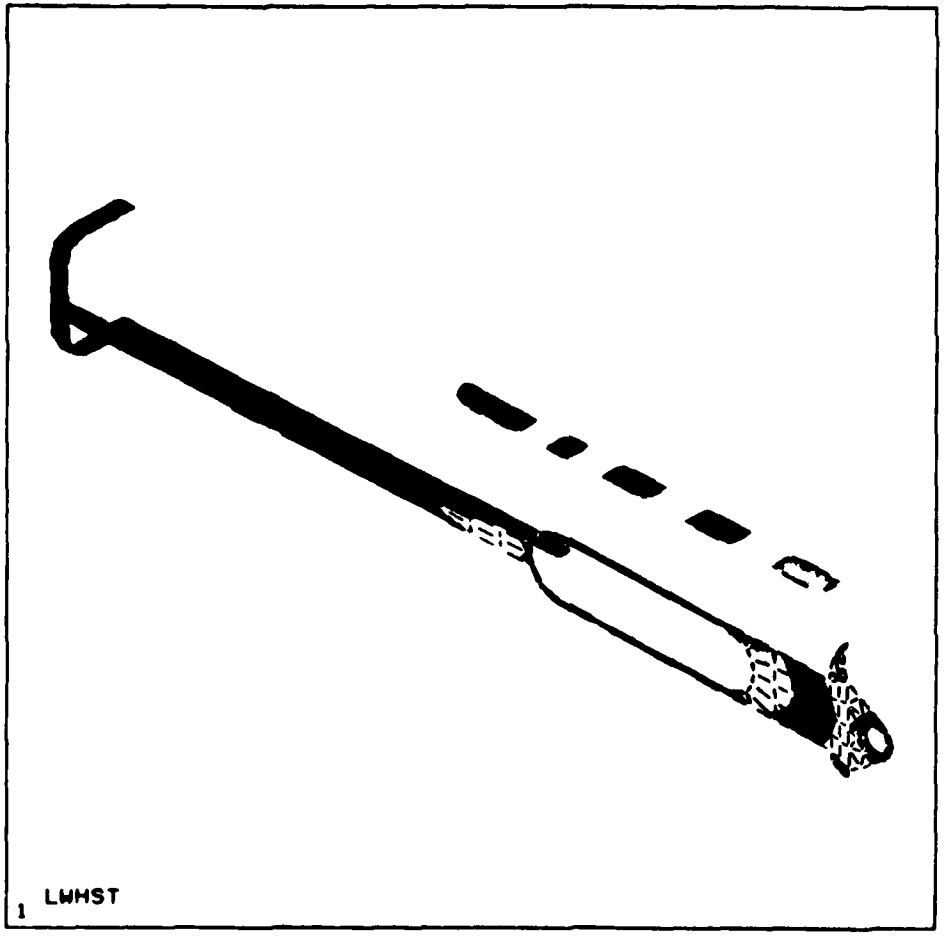
ANSYS 4.2B
MAR 3 1987
7:29:11
PLOT NO. 12
POST1 STRESS
STEP=1
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=7865
MN=-25964
-22206
-18447
-14688
-10929
-7170
4107
7866



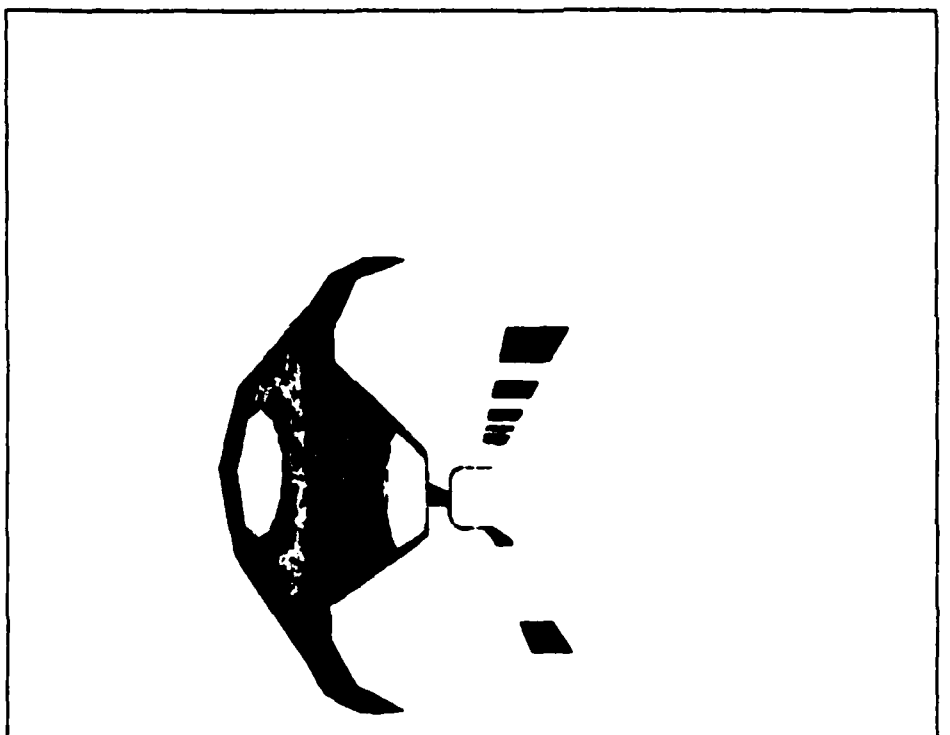
ANSYS 4.2B
MAR 3 1987
7:29:28
PLOT NO. 13
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=9526
MN=-6205
-4457
-2709
-961
787
2535



ANSYS 4.2B
MAR 3 1987
7:29:36
PLOT NO. 14
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

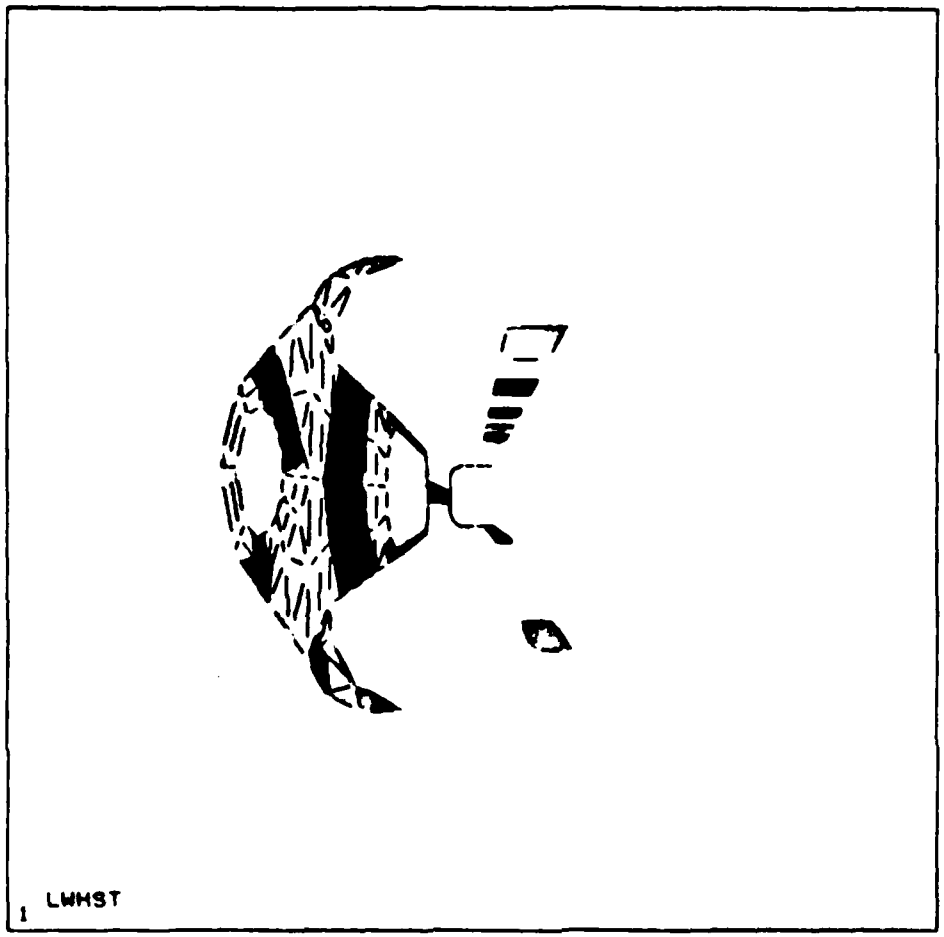
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=6780
MN=-19777
-16827
-13876
-10925
-7974
-5023



ANSYS 4.2B
MAR 3 1987
7:29:45
PLOT NO. 15
POST1 STRESS
STEP=1
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=9526
MN=-6205
-4457
-2709
-961
787
2535

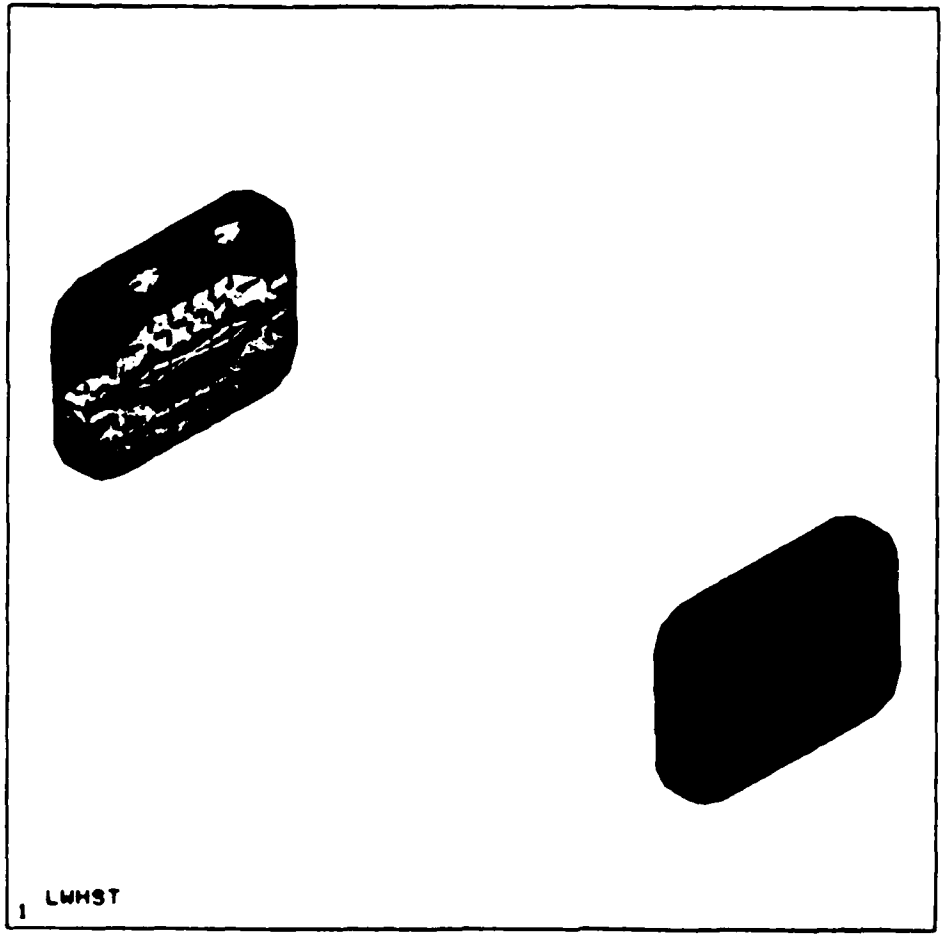
7779
9527



ANSYS 4.2B
MAR 3 1987
7:29:53
PLOT NO. 16
POST1 STRESS
STEP=1
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=6780
MN=-19777
-16827
-13876
-10925
-7974
-5023

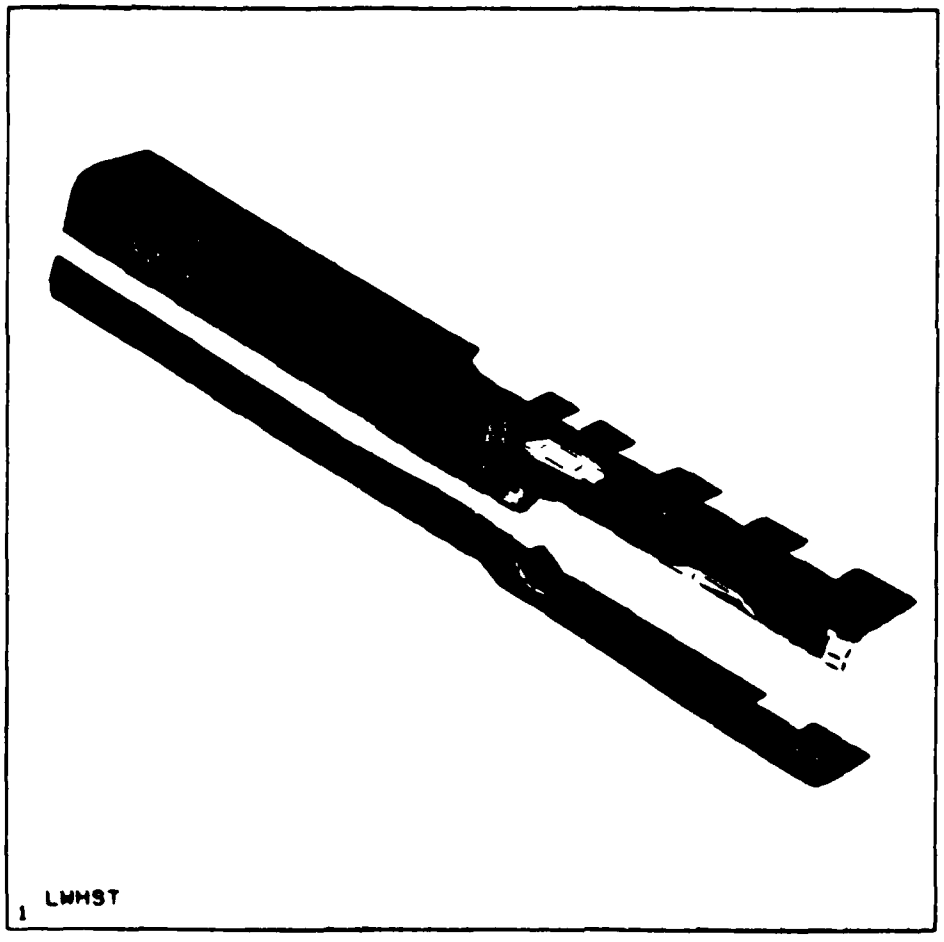
3830
6781



ANSYS 4.2B
MAR 3 1987
7:30:15
PLOT NO. 17
POST1 STRESS
STEP=1
ITER=1
SIGE
BOTTOM

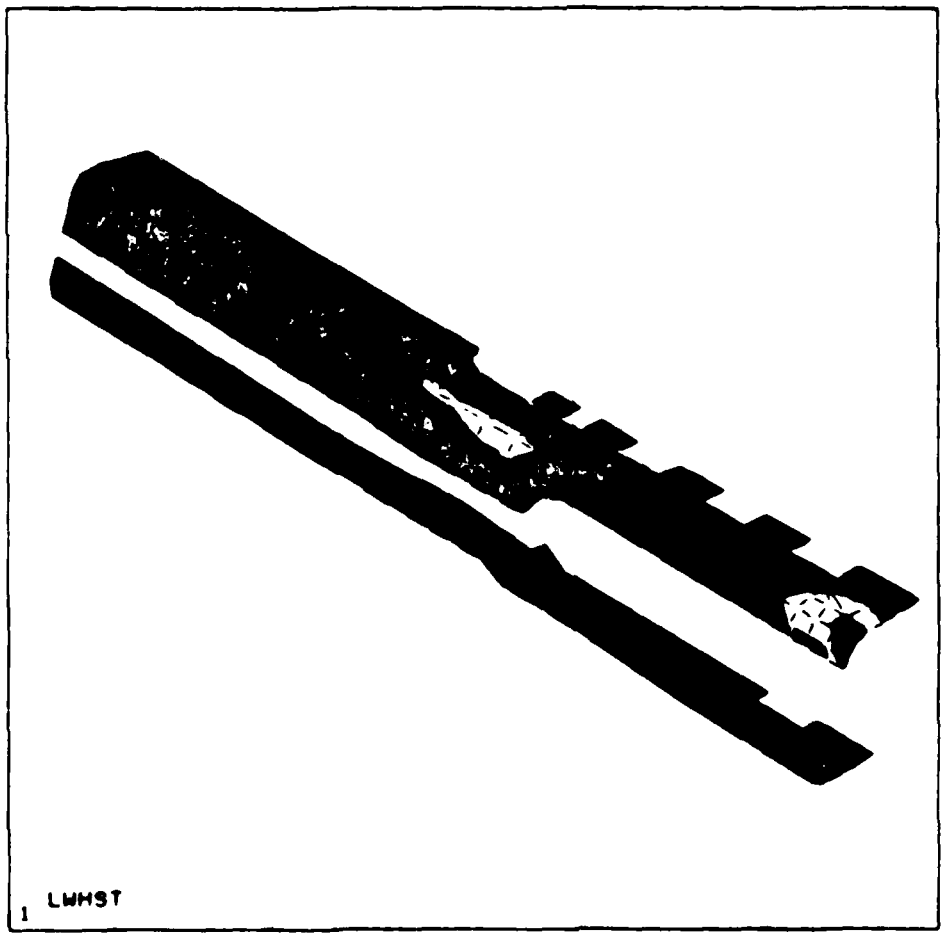
XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2418
MN=5.74
270
539
808
1077
1346

2153
2422



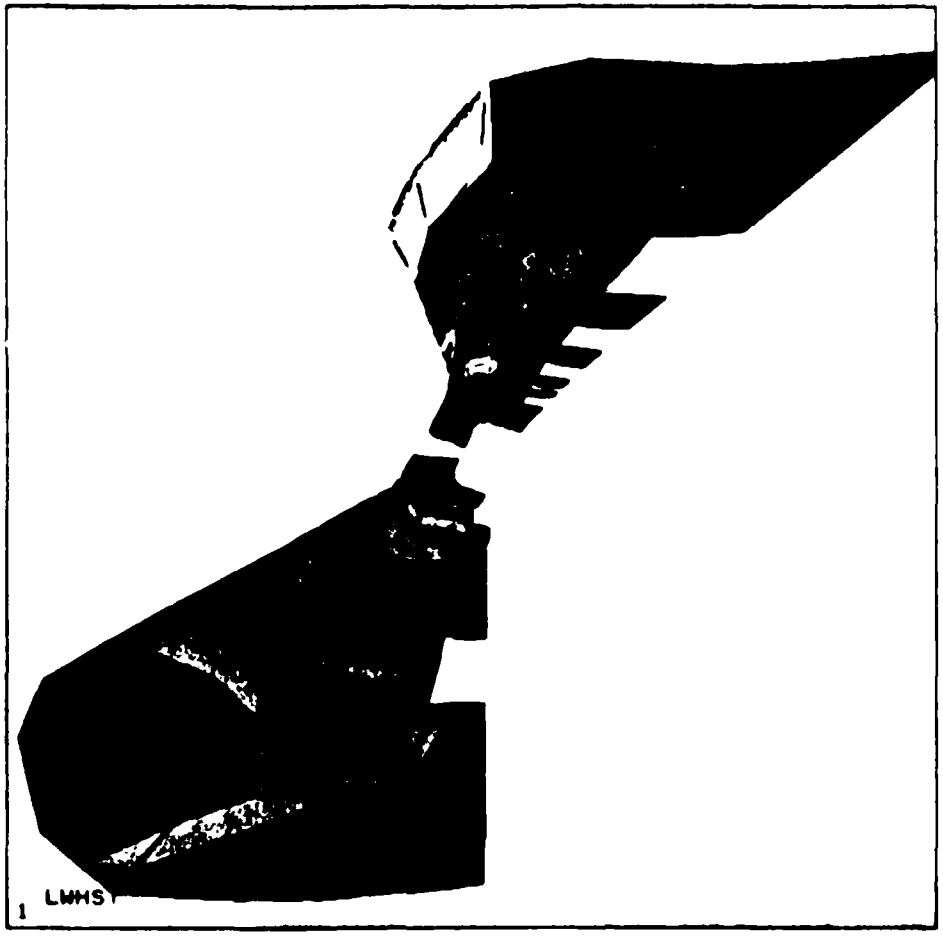
ANSYS 4.2B
MAR 3 1987
7:31:52
PLOT NO. 18
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=11581
MN=-6560
-4544
-2527
-510
1507
3524



ANSYS 4.2B
MAR 3 1987
7:32:11
PLOT NO. 19
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

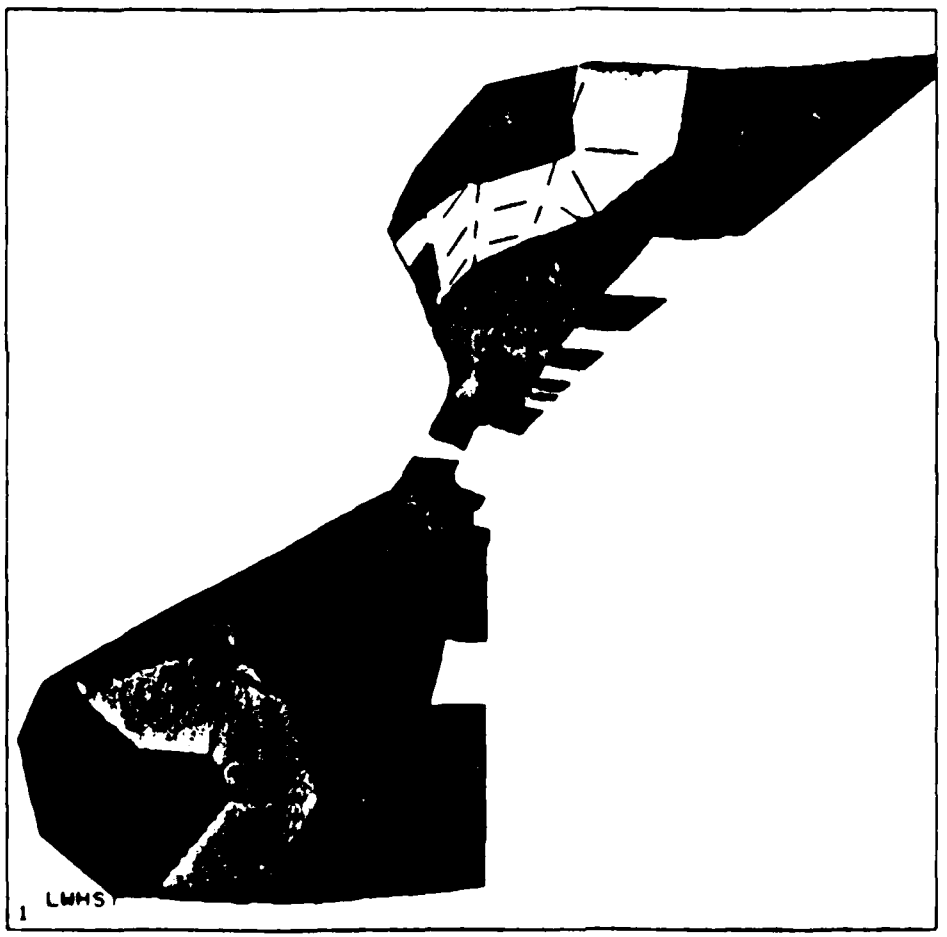
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=18055
MN=-17971
-13968
-9965
-5962
-1959
2044



ANSYS 4.2B
MAR 3 1987
7:32:26
PLOT NO. 20
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=11591
MN=-6560
-4544
-2527
-510
1507
3524

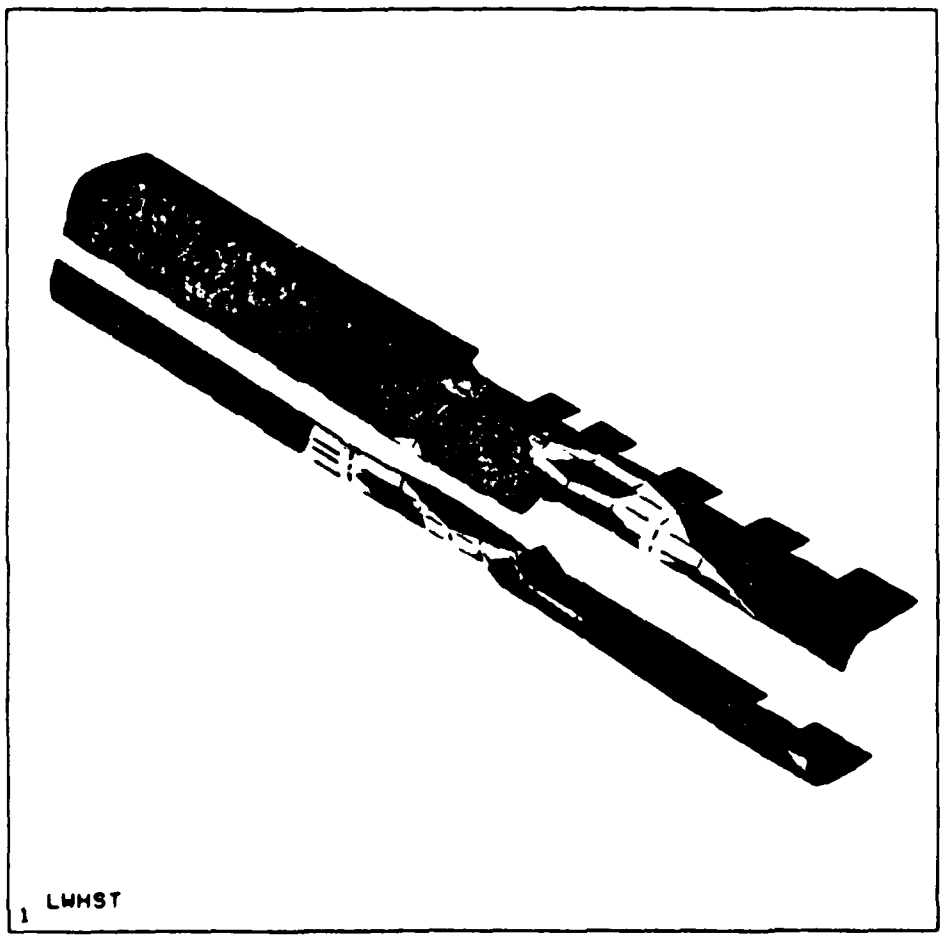
9575
11592



ANSYS 4.2B
MAR 3 1987
7:32:41
PLOT NO. 21
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

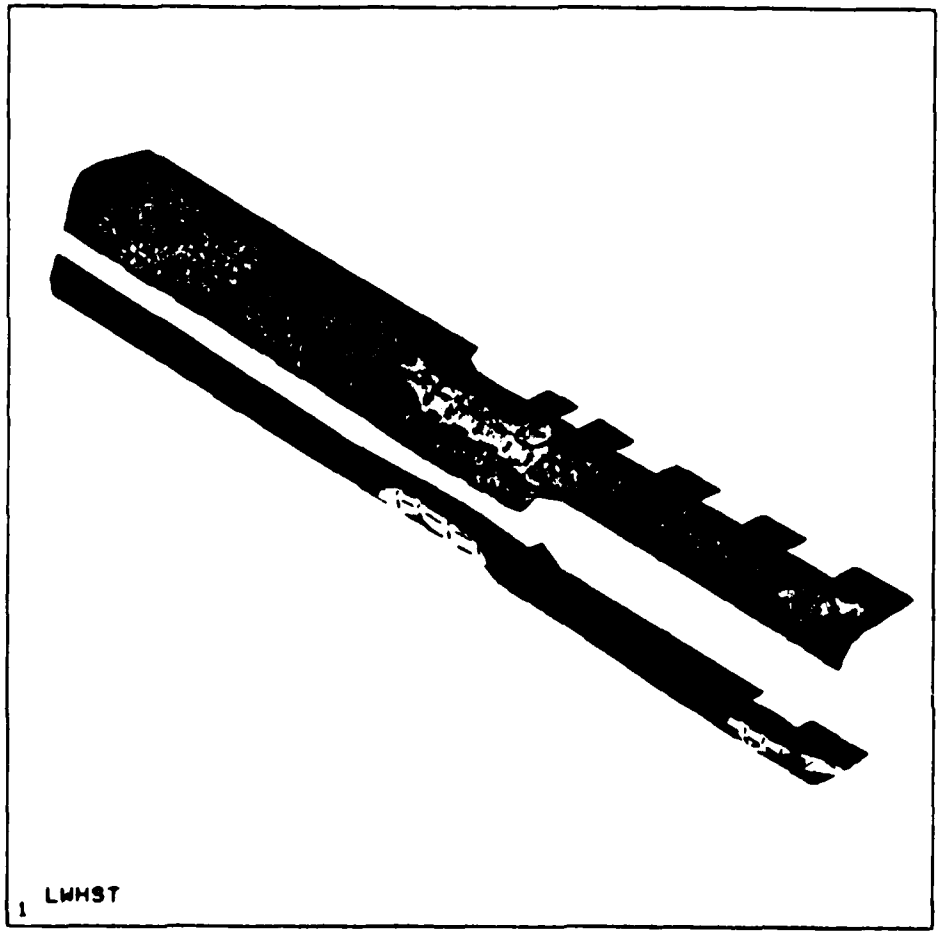
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=18055
MN=-17971
-13968
-9965
-5962
-1959
2044

14053
18056



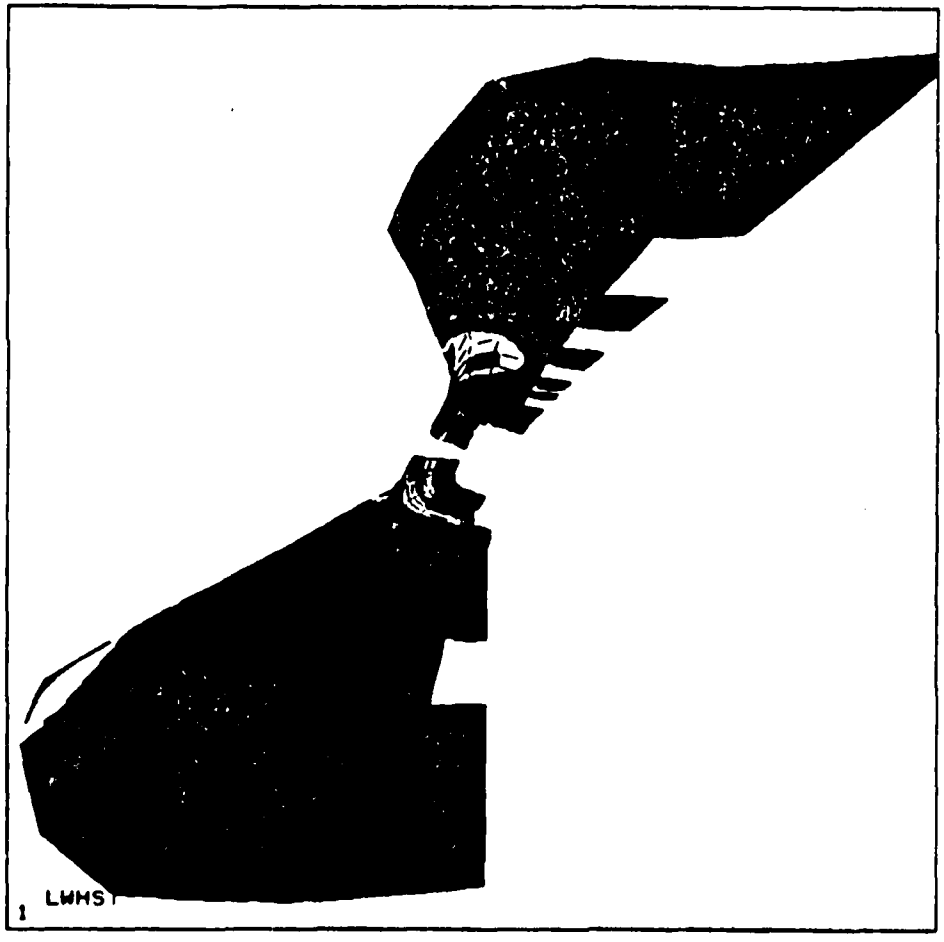
ANSYS 4.2B
MAR 3 1987
7:33:08
PLOT NO. 22
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=8569
MN=-7160
-5414
-3666
-1918
-170
1578



ANSYS 4.2B
MAR 3 1987
7:33:23
PLOT NO. 23
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

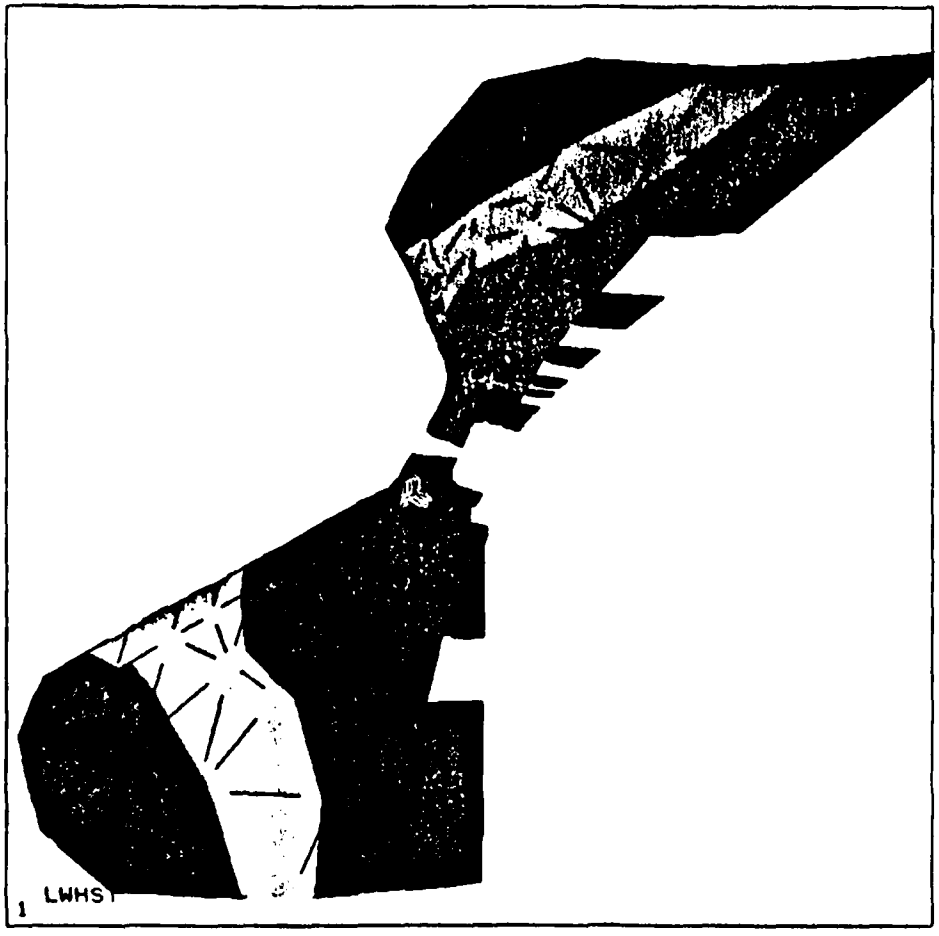
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=13501
MN=-13294
-10320
-7342
-4364
-1386
1592



ANSYS 4.2B
MAR 3 1987
7:33:38
PLOT NO. 24
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=8569
MN=-7160
-5414
-3666
-1918
-170
1578

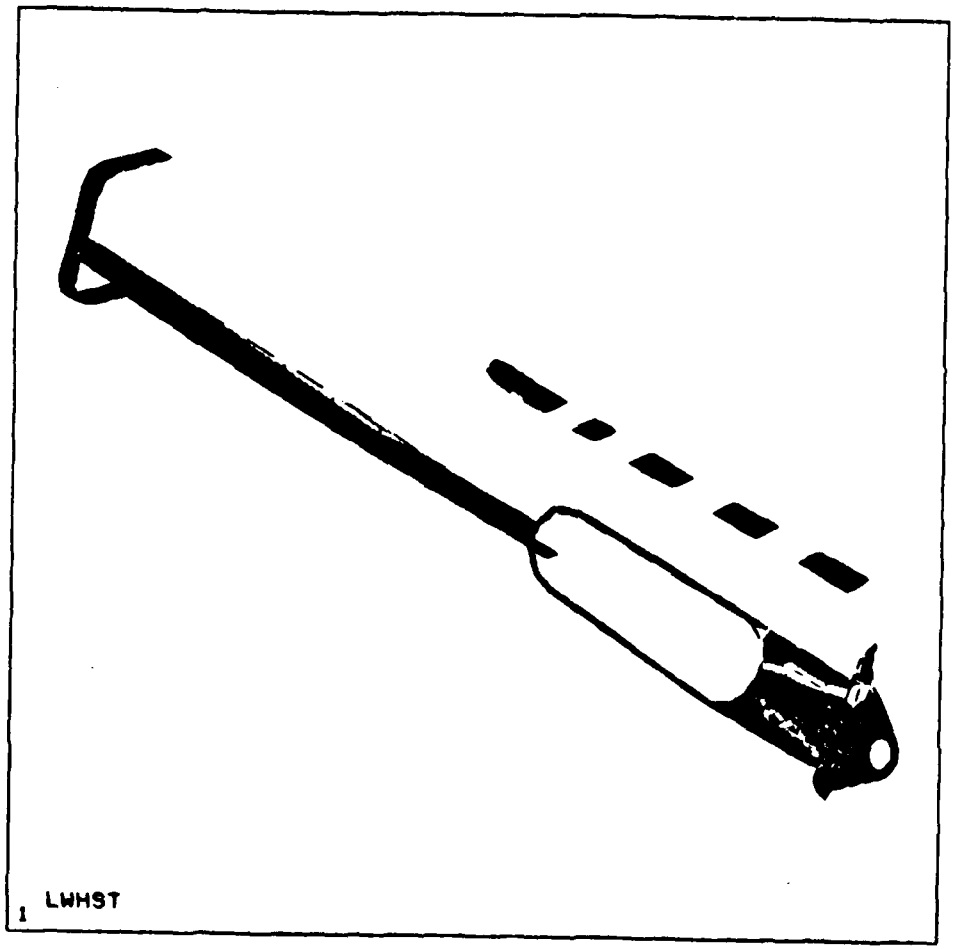
6822
8570



ANSYS 4.2B
MAR 3 1987
7:33:55
PLOT NO. 25
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

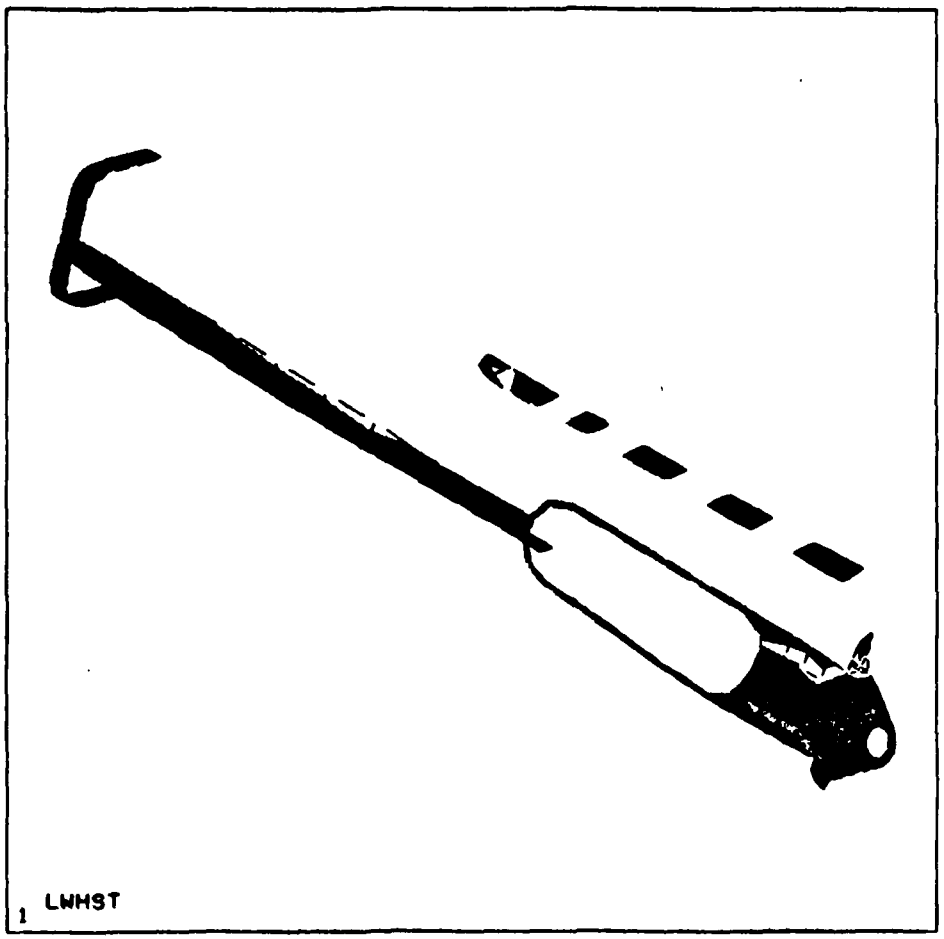
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=13501
MN=-13294
-10320
-7342
-4364
-1386
1592

10526
13504



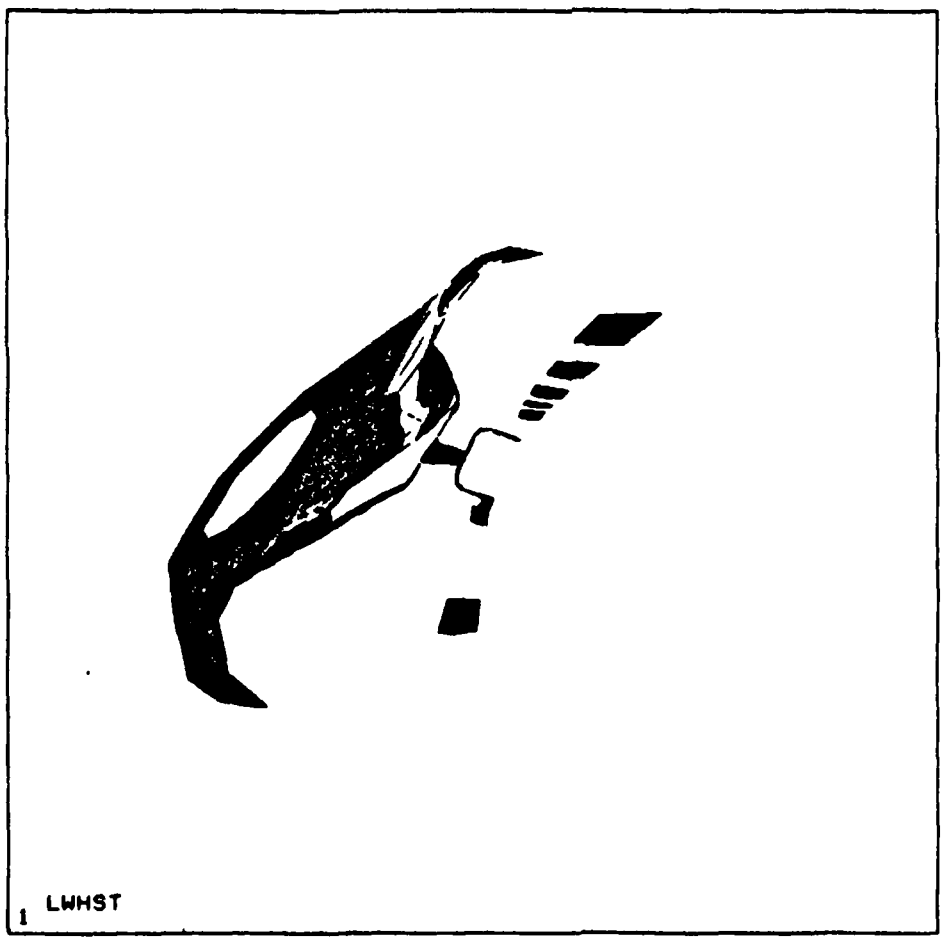
ANSYS 4.2B
MAR 3 1987
7:34:26
PLOT NO. 26
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=22505
MN=-22464
-17469
-12472
-7475
-2478
2519



ANSYS 4.2B
MAR 3 1987
7:34:35
PLOT NO. 27
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

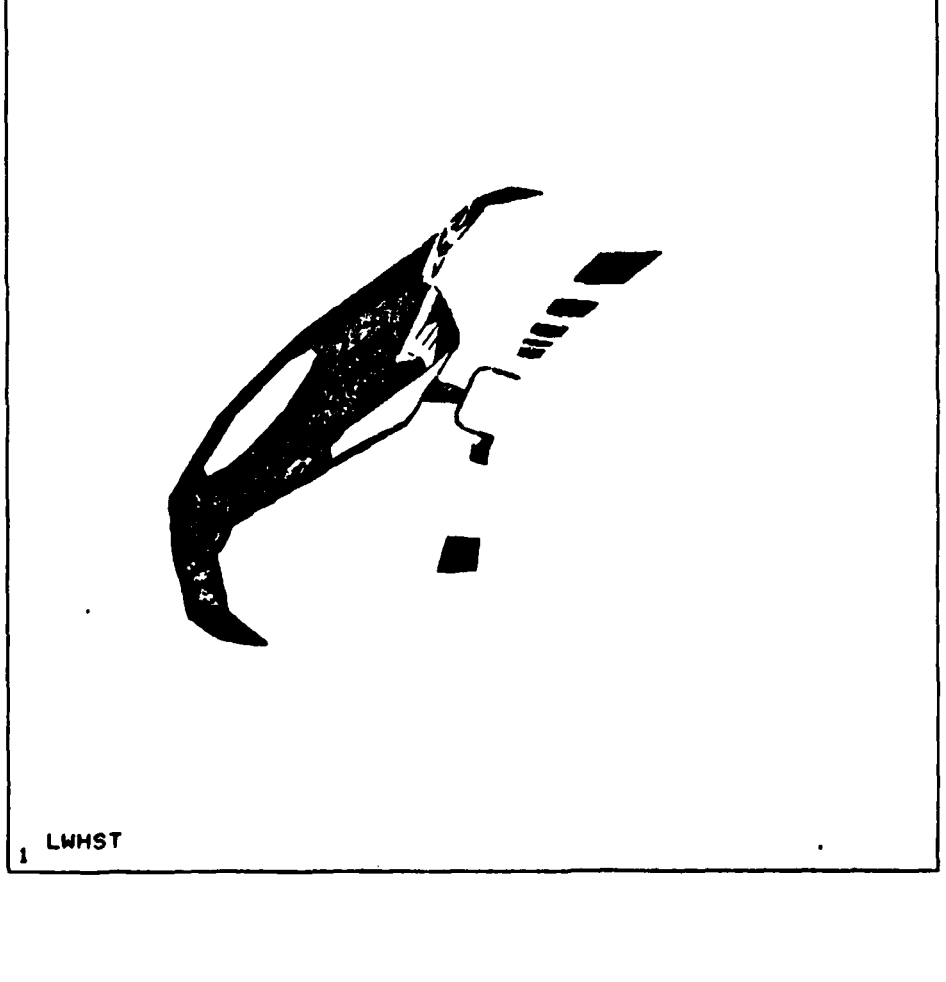
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=14089
MN=-13785
-10691
-7593
-4495
-1397
1701



ANSYS 4.2B
MAR 3 1987
7:34:43
PLOT NO. 28
POST1 STRESS
STEP=2
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=22505
MN=-22464
-17469
-12472
-7475
-2478
2519

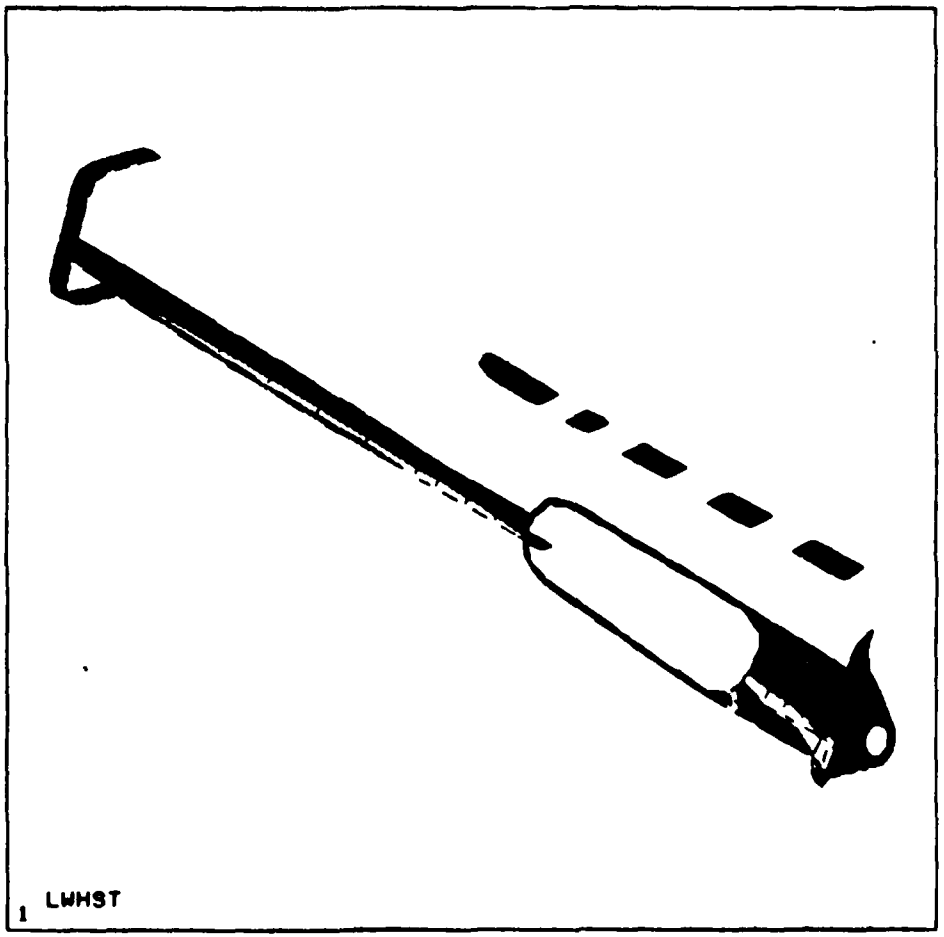
17510
22507



ANSYS 4.2B
MAR 3 1987
7:34:53
PLOT NO. 29
POST1 STRESS
STEP=2
ITER=1
SY
TOP
STRESS ELEM CS

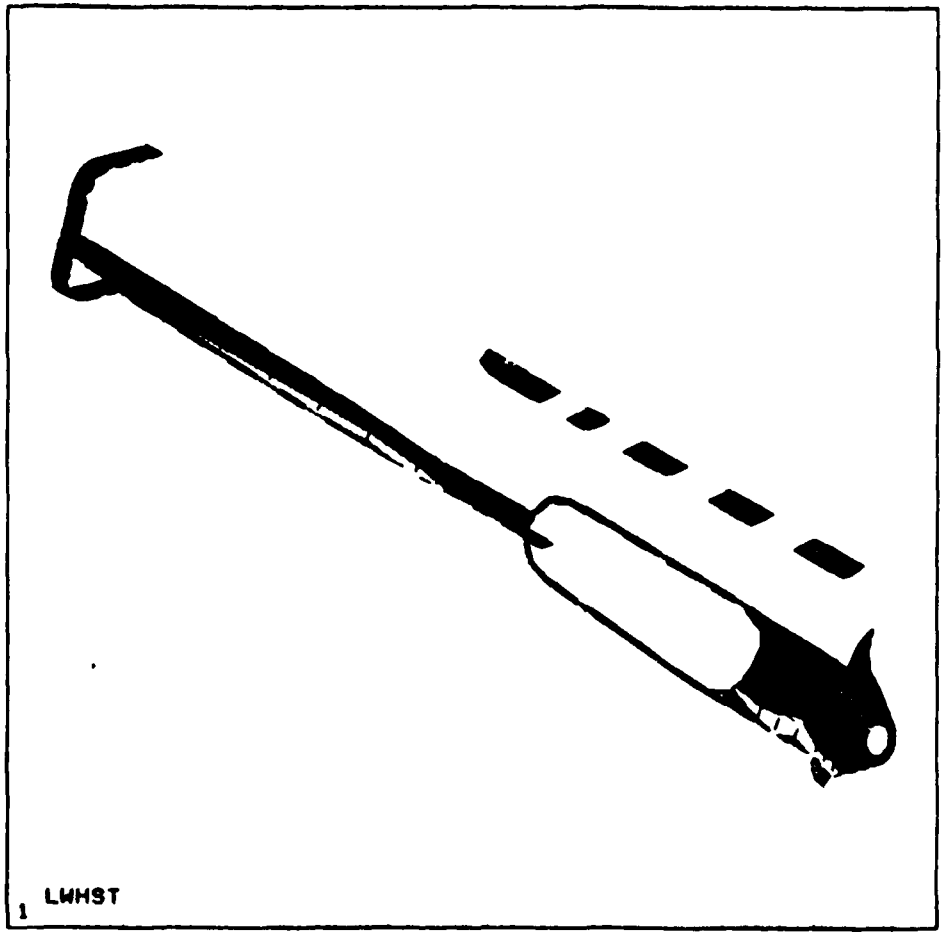
ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=14089
MN=-13785
-10691
-7593
-4495
-1397
1701

10995
14093



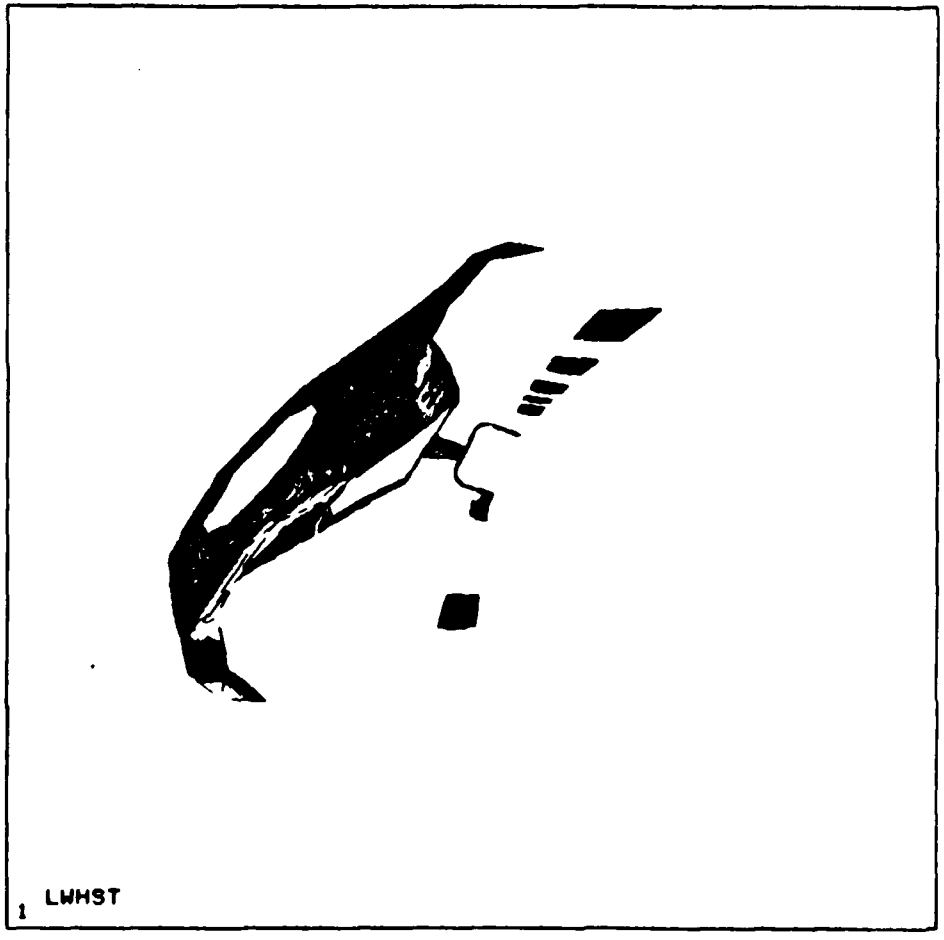
ANSYS 4.2B
MAR 3 1987
7:35:09
PLOT NO. 30
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=22872
MN=-27908
-22268
-16625
-10982
-5339
304



ANSYS 4.2B
MAR 3 1987
7:35:17
PLOT NO. 31
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

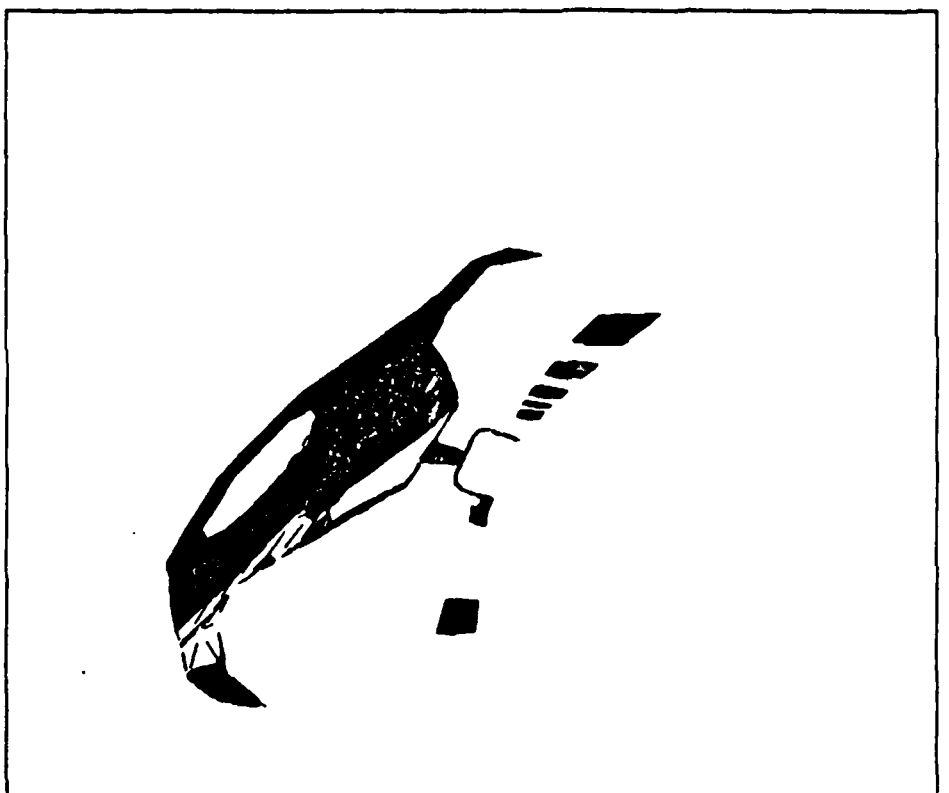
XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=12133
MN=-11642
-9001
-6359
-3717
-1075
1567



ANSYS 4.2B
MAR 3 1987
7:35:27
PLOT NO. 32
POST1 STRESS
STEP=2
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=22872
MN=-27908
-22268
-16625
-10982
-5339
304

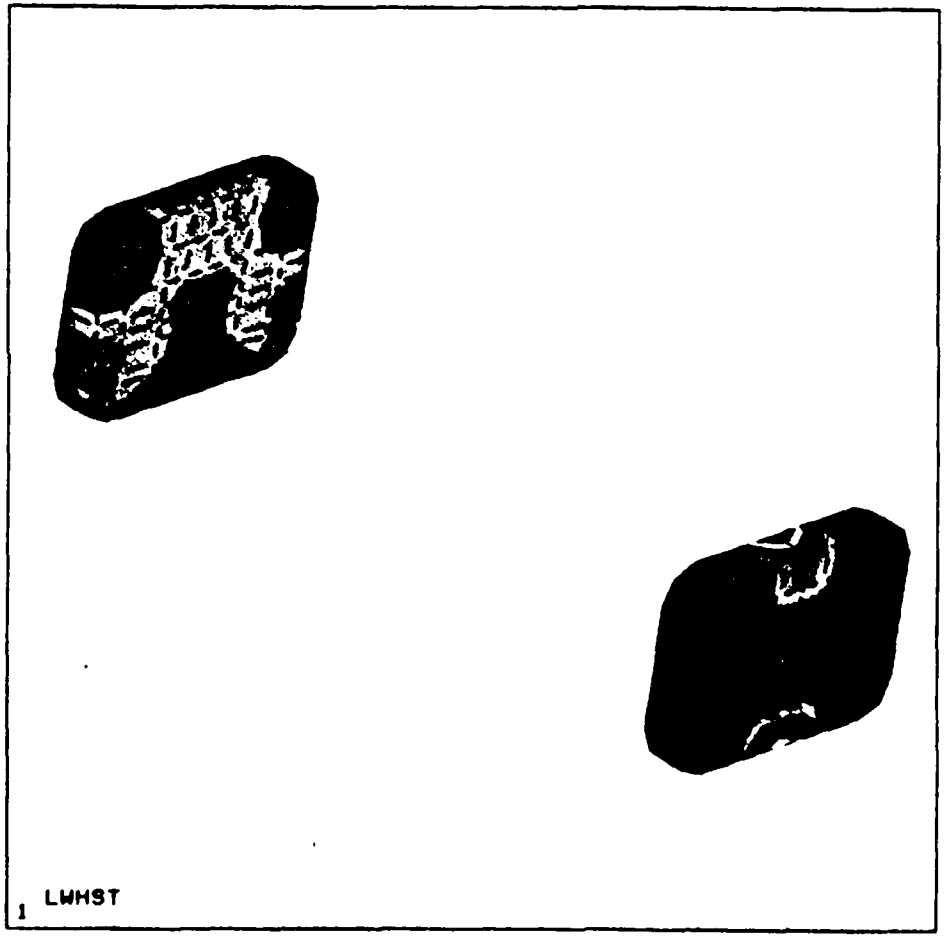
17233
22876



ANSYS 4.2B
MAR 3 1987
7:35:36
PLOT NO. 33
POST1 STRESS
STEP=2
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=12133
MN=-11642
-9001
-6359
-3717
-1075
1567

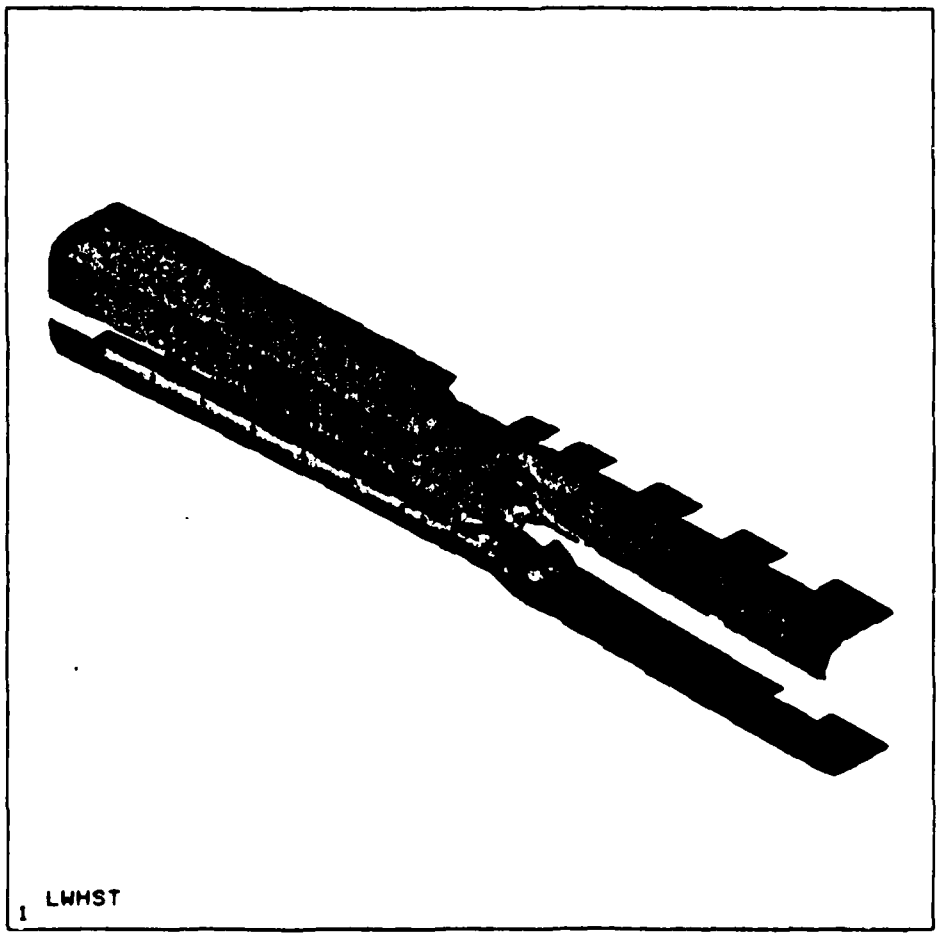
9493
12135



ANSYS 4.2B
MAR 3 1987
7:35:57
PLOT NO. 34
POST1 STRESS
STEP=2
ITER=1
SIGE
BOTTOM

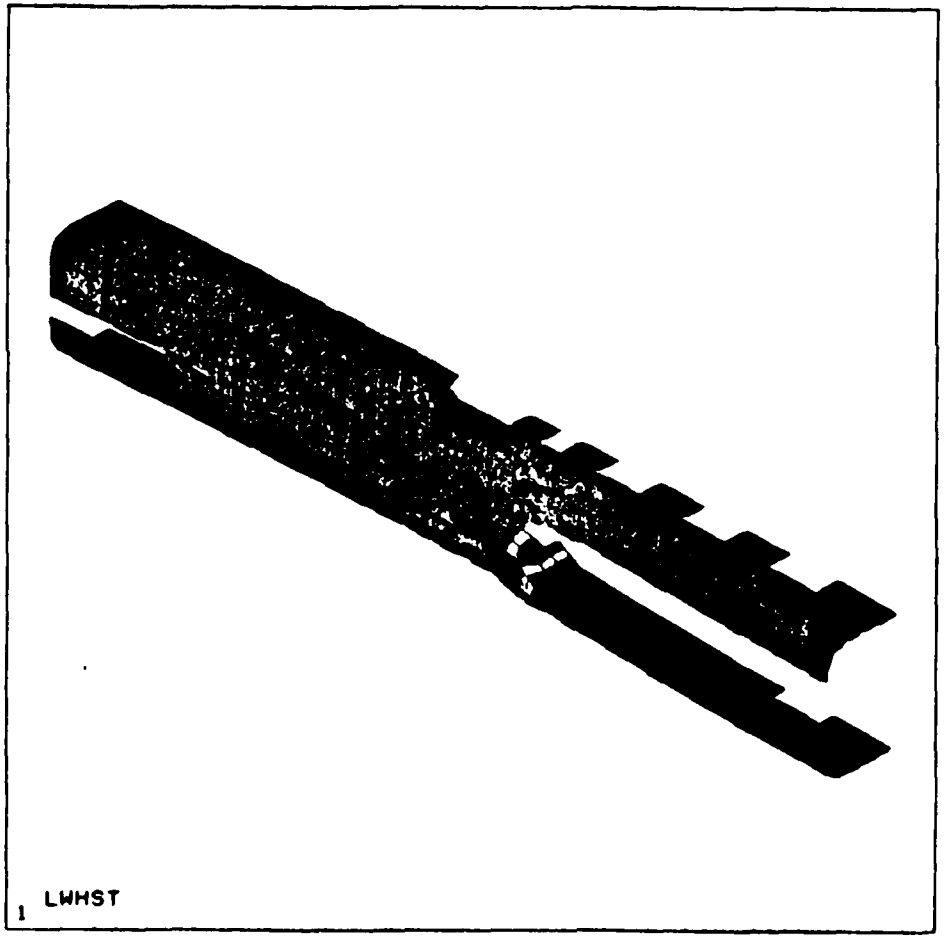
XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=1147
MN=18.9
142
268
394
520
646

1024
1150



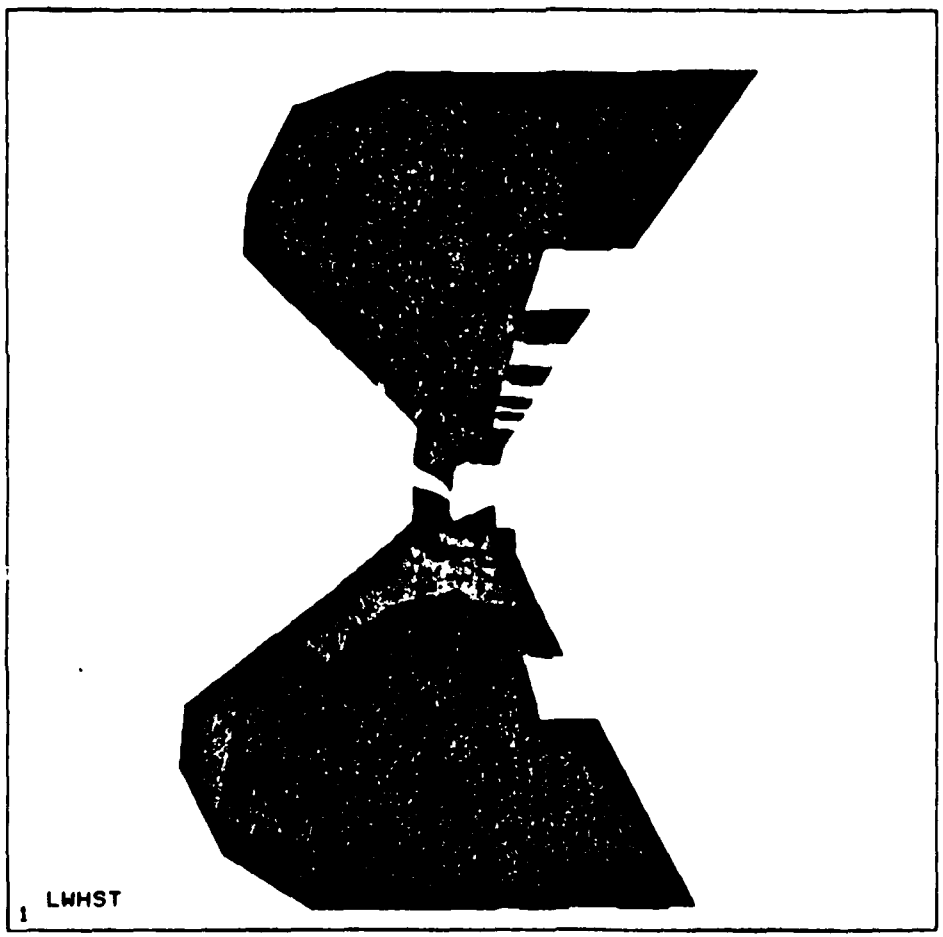
ANSYS 4.2B
MAR 3 1987
7:37:30
PLOT NO. 35
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=9579
MN=-6599
-4803
-3005
-1207
591
2389



ANSYS 4.2B
MAR 3 1987
7:37:49
PLOT NO. 36
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

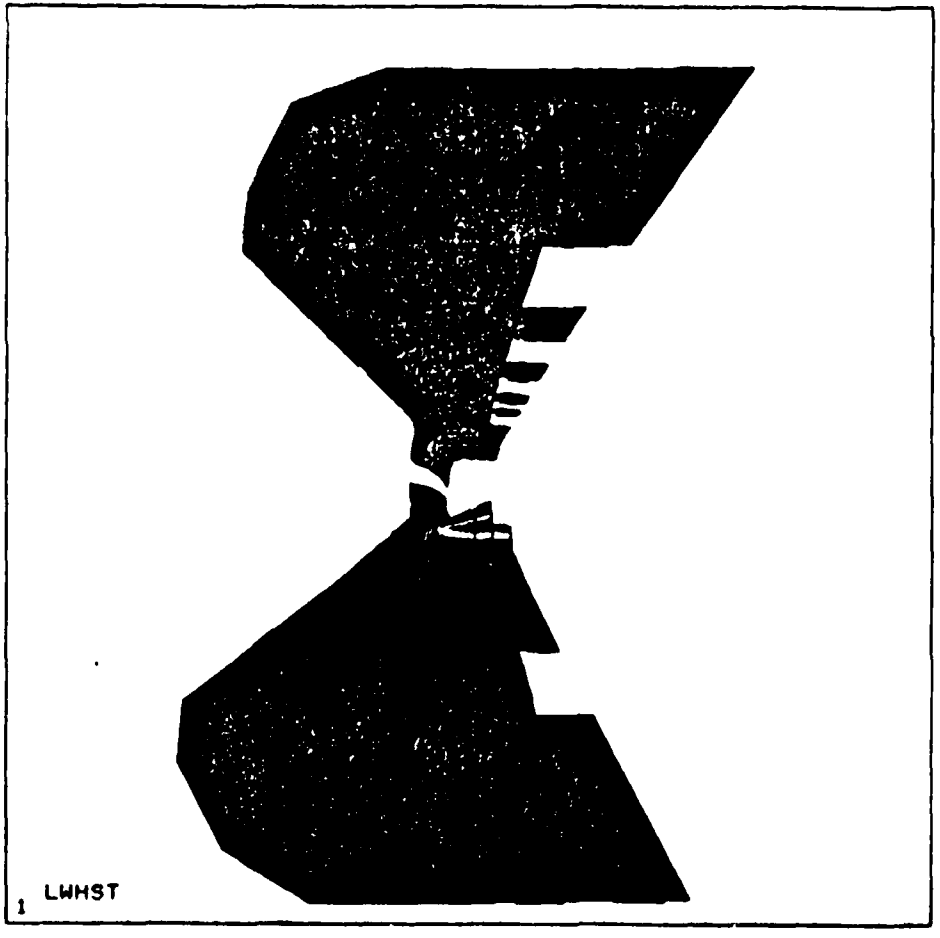
XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=8629
MN=-8646
-6729
-4809
-2889
-969
951



ANSYS 4.2B
MAR 3 1987
7:38:05
PLOT NO. 37
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=9579
MN=-6599
-4803
-3005
-1207
591
2389

7783
9581

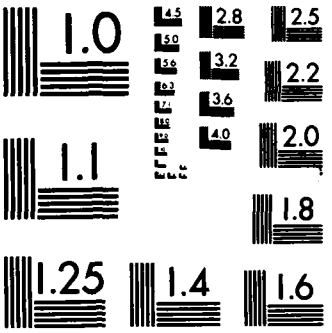


ANSYS 4.2B
MAR 3 1987
7:38:21
PLOT NO. 38
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

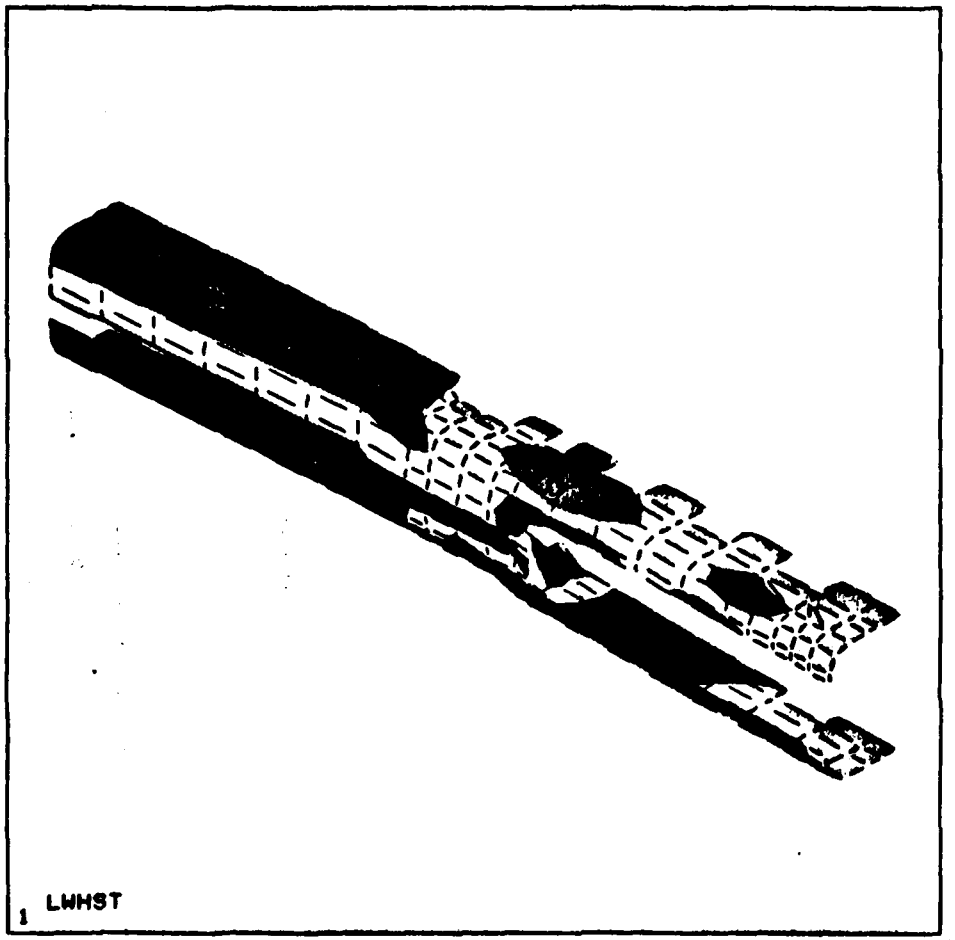
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=8629
MN=-8646
-6729
-4809
-2889
-969
951
6711
8631

AD-A183 991 LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN NORTHERN ORDNANCE DIV R RATHE ET AL APR 87 5/5

UNCLASSIFIED FMC-E-3041-VOL-D2-PT-3 DAAA21-86-C-0047 F/G 19/6 NL

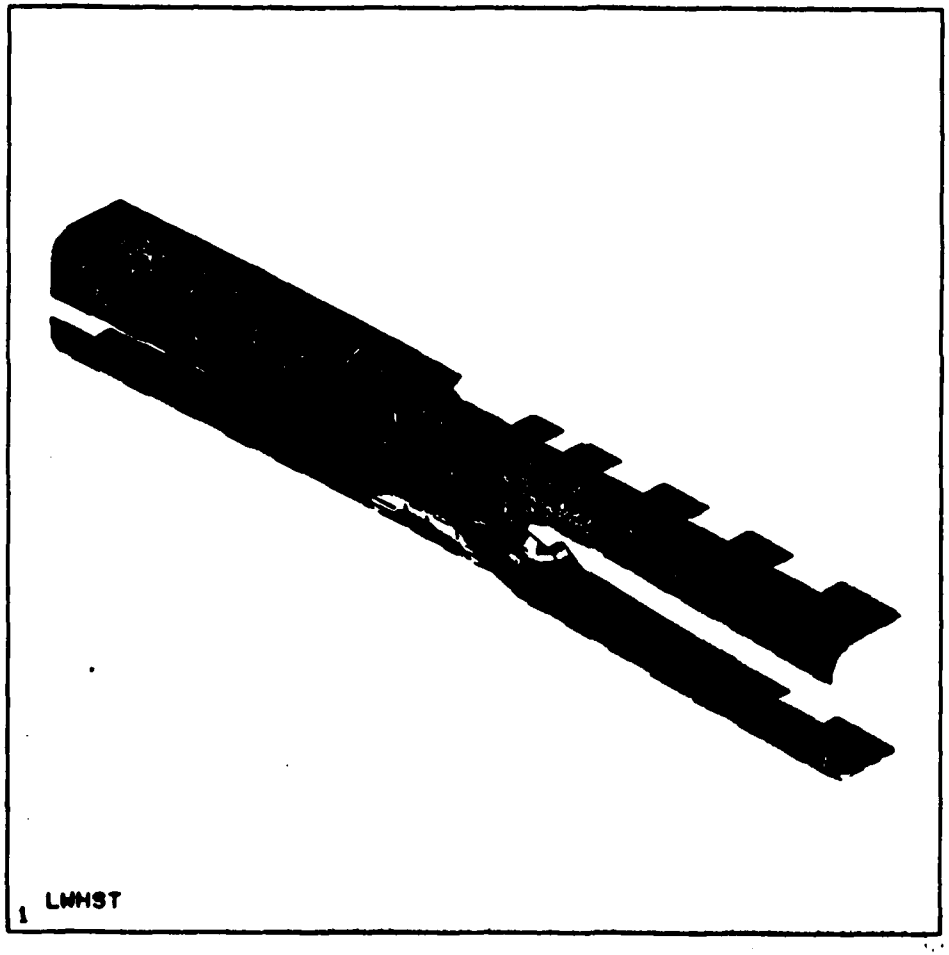


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



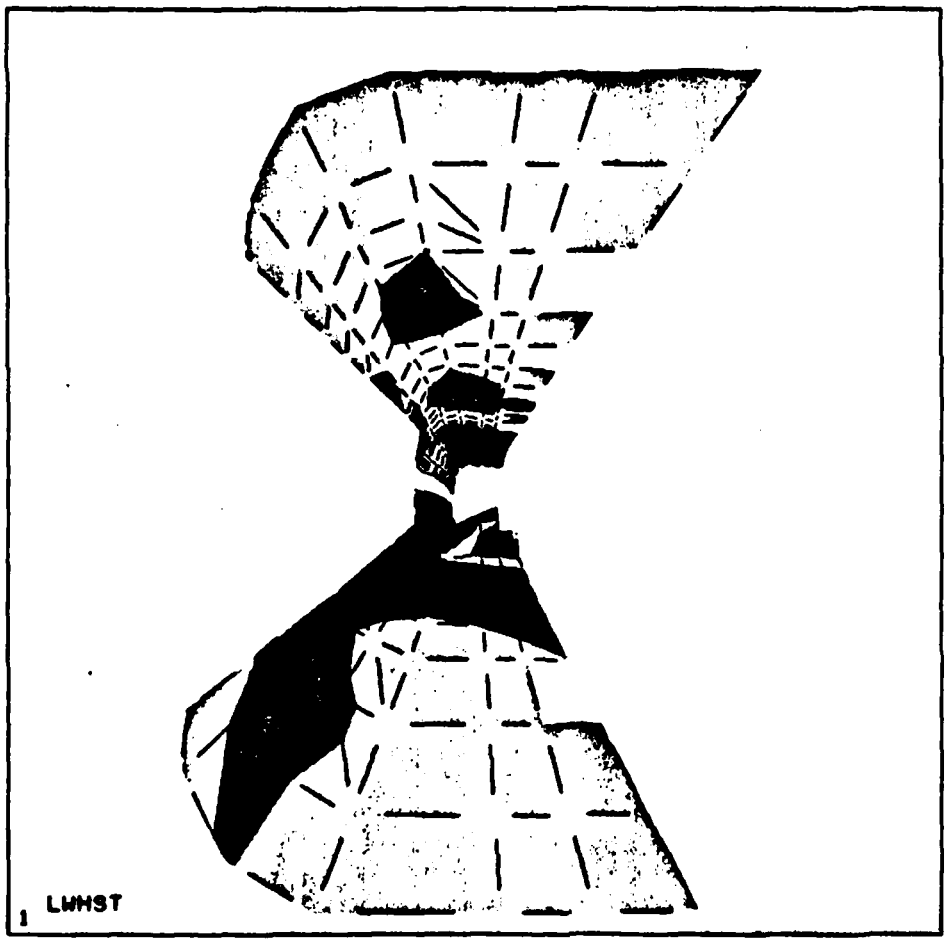
ANSYS 4.2B
MAR 3 1987
7:38:46
PLOT NO. 39
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=5692
MN=-12880
-10818
-8754
-6690
-4626
-2562
-499
1566



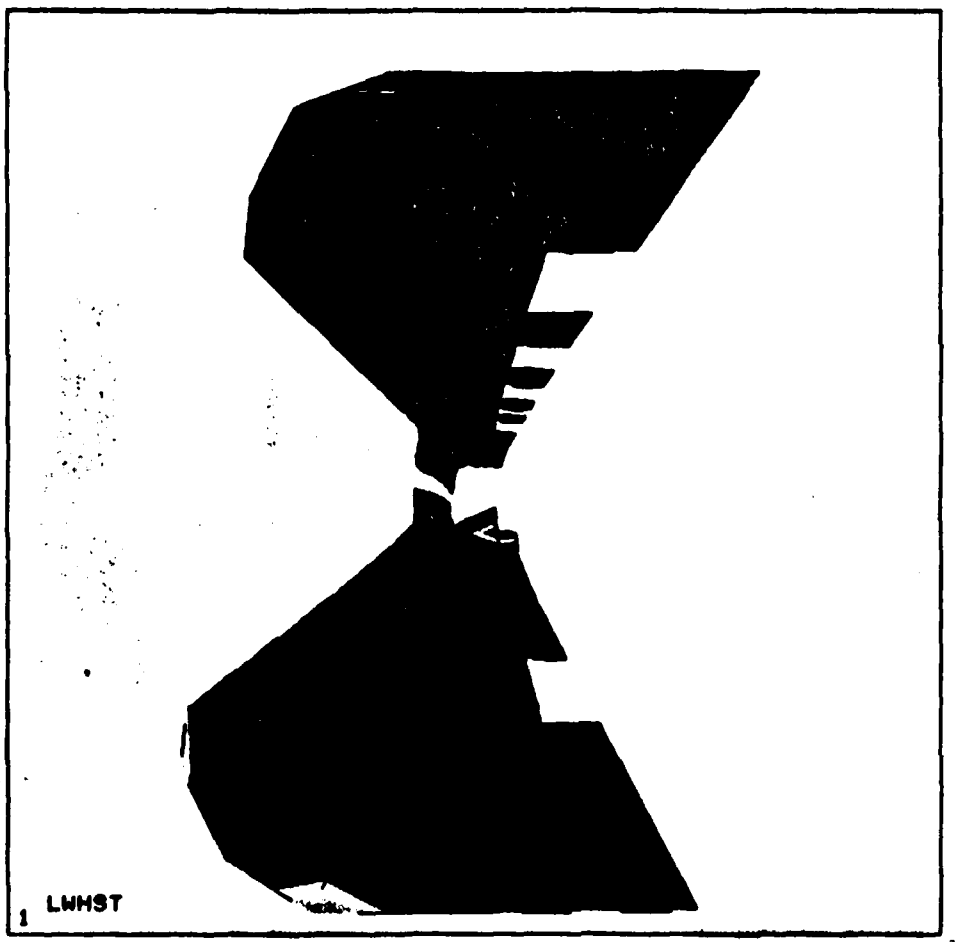
ANSYS 4.2B
MAR 3 1987
7:39:02
PLOT NO. 40
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=5976
MN=-7527
-6029
-4528
-3027
-1526
-25.1
1476
2977



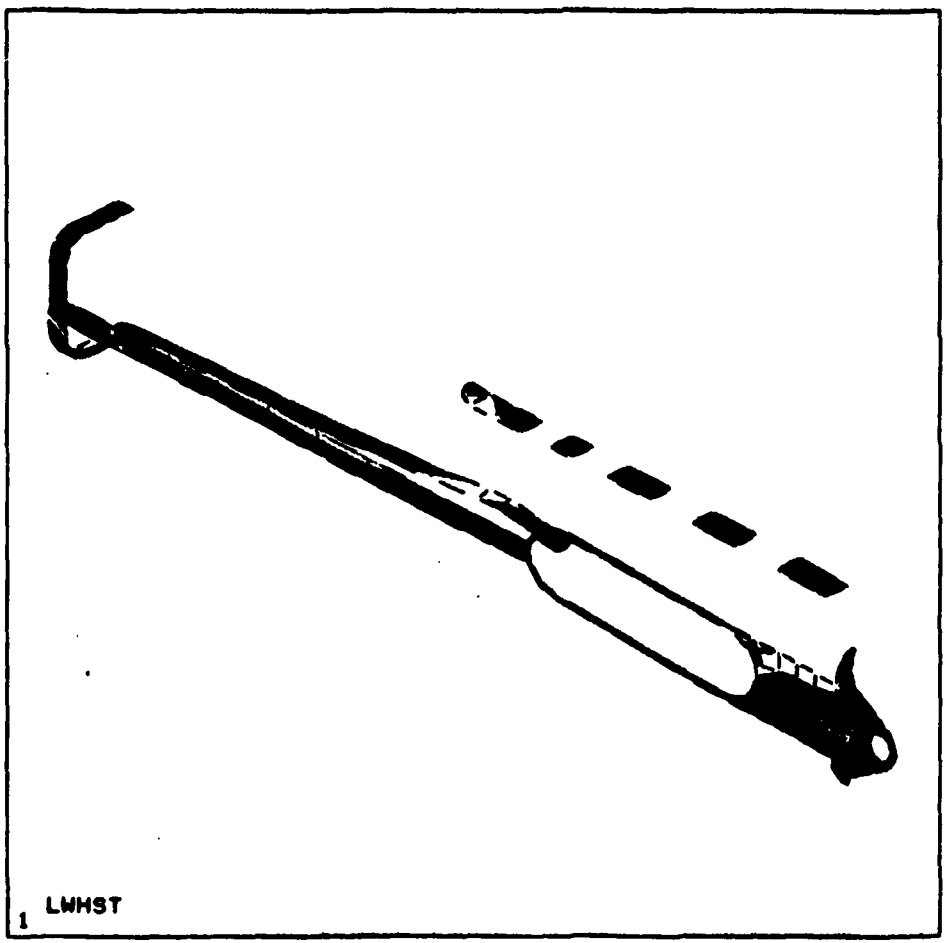
ANSYS 4.2B
MAR 3 1987
7:39:18
PLOT NO. 41
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=5692
MN=-12880
-10818
-8754
-6690
-4626
-2562
.
.
.
3630
5694



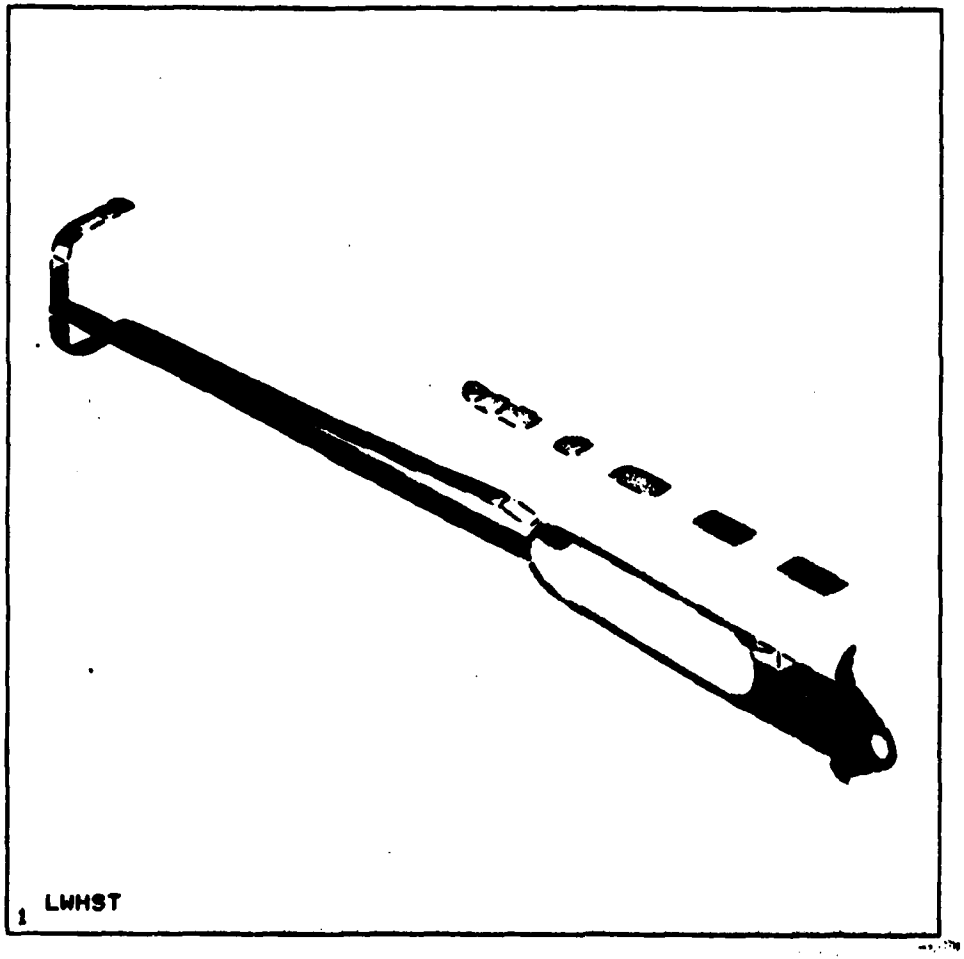
ANSYS 4.2B
MAR 3 1987
7:39:34
PLOT NO. 42
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=5976
MN=-7527
-6029
-4528
-3027
-1526
-25.1
1478
4478
5979



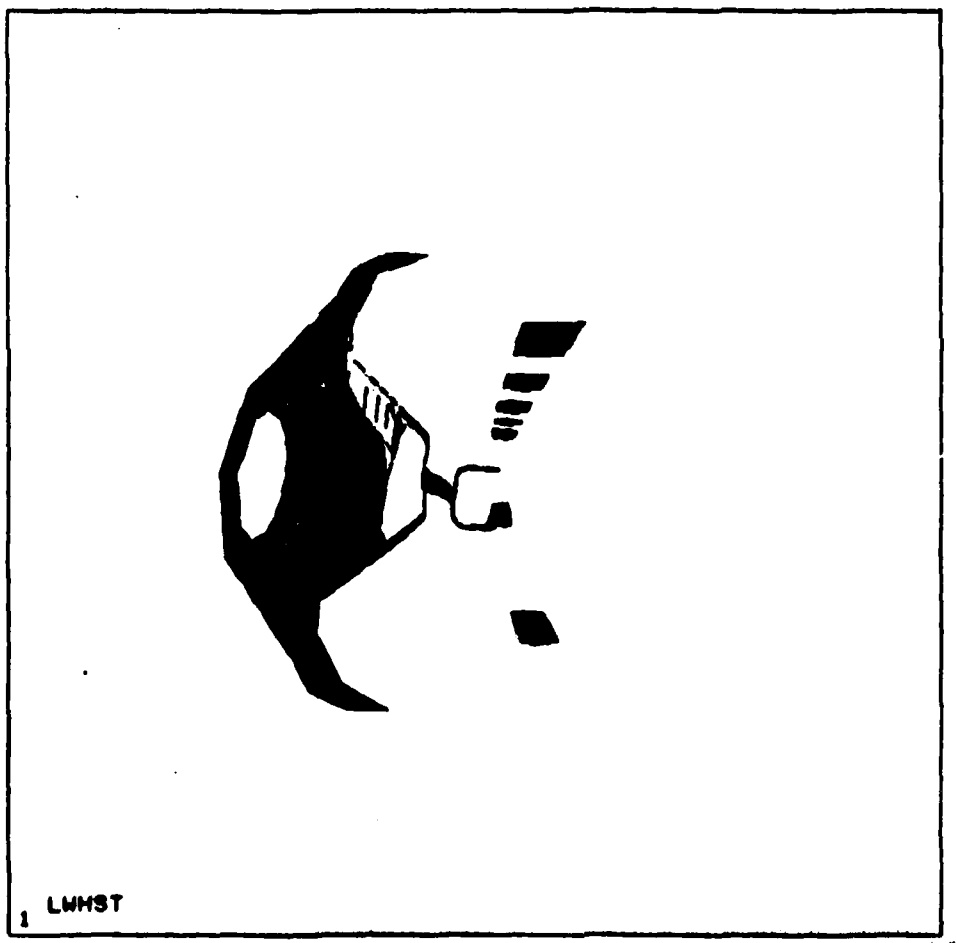
ANSYS 4.2B
MAR 3 1987
7:40:04
PLOT NO. 43
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=7273
MN=-10447
-8479
-6510
-4541
-2572
-603



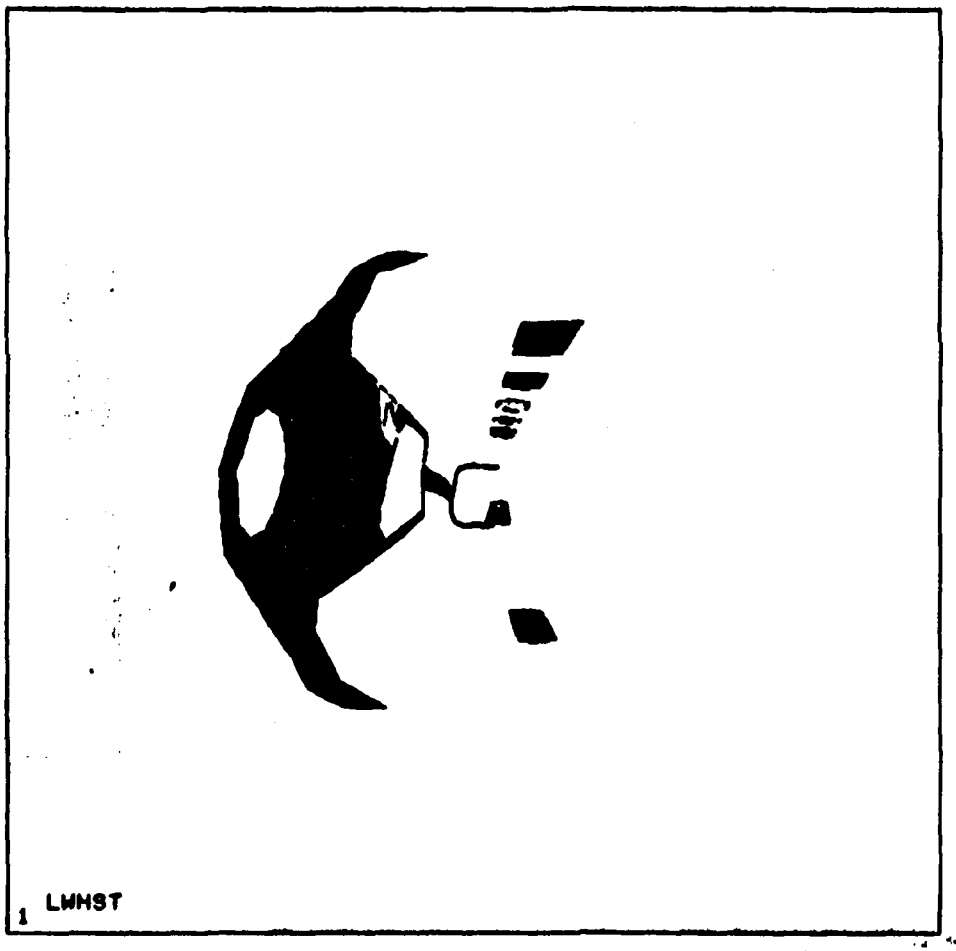
ANSYS 4.2B
MAR 3 1987
7:40:14
PLOT NO. 44
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=6464
MN=-9352
-7597
-5839
-4081
-2323
-565
1193
3951



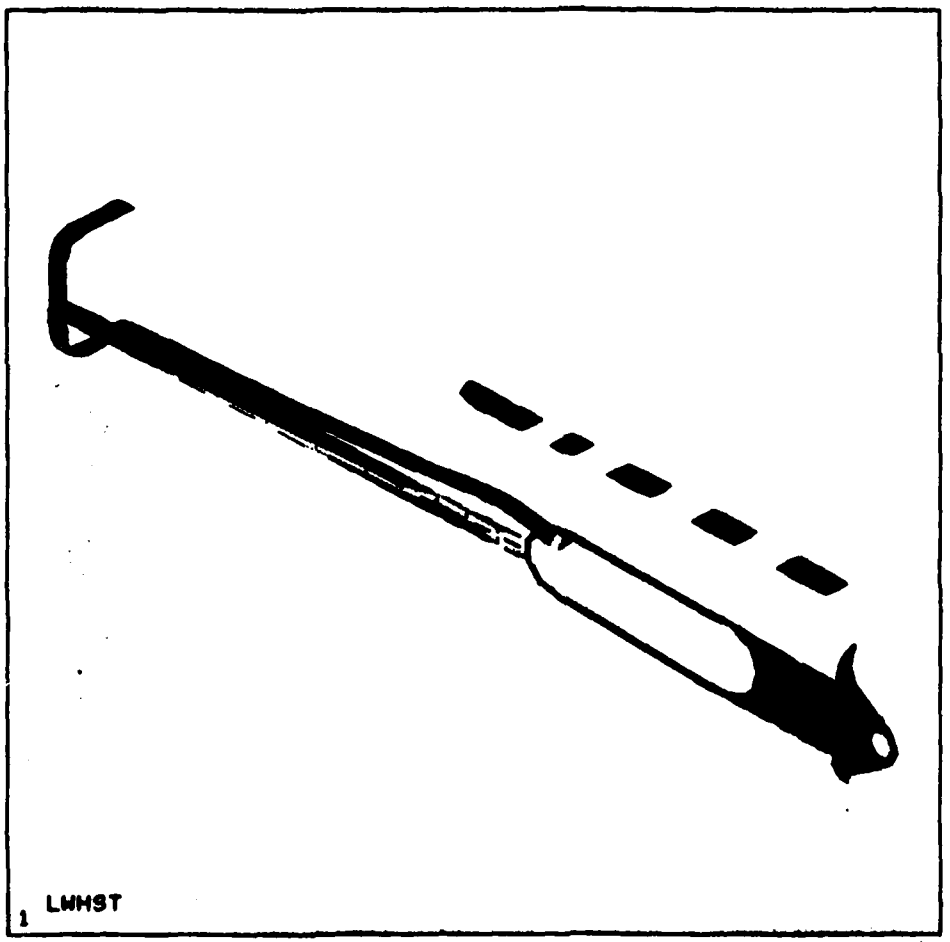
ANSYS 4.2B
MAR 3 1987
7:40:22
PLOT NO. 45
POST1 STRESS
STEP=3
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=7273
MN=-10447
-8479
-6510
-4541
-2572
-603
[illegible]
[illegible]
5304
7273



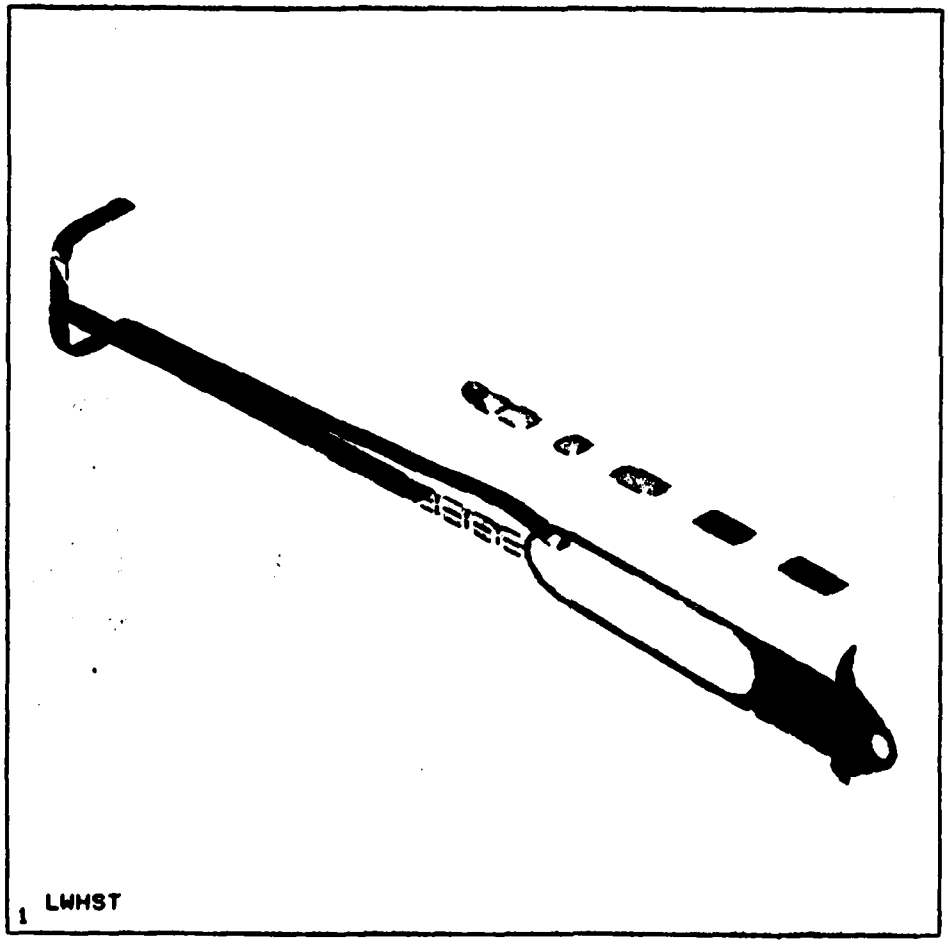
ANSYS 4.2B
MAR 3 1987
7:40:30
PLOT NO. 46
POST1 STRESS
STEP=3
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=6464
MN=-9352
-7597
-5839
-4081
-2323
-565
[illegible]
[illegible]
4709
6467



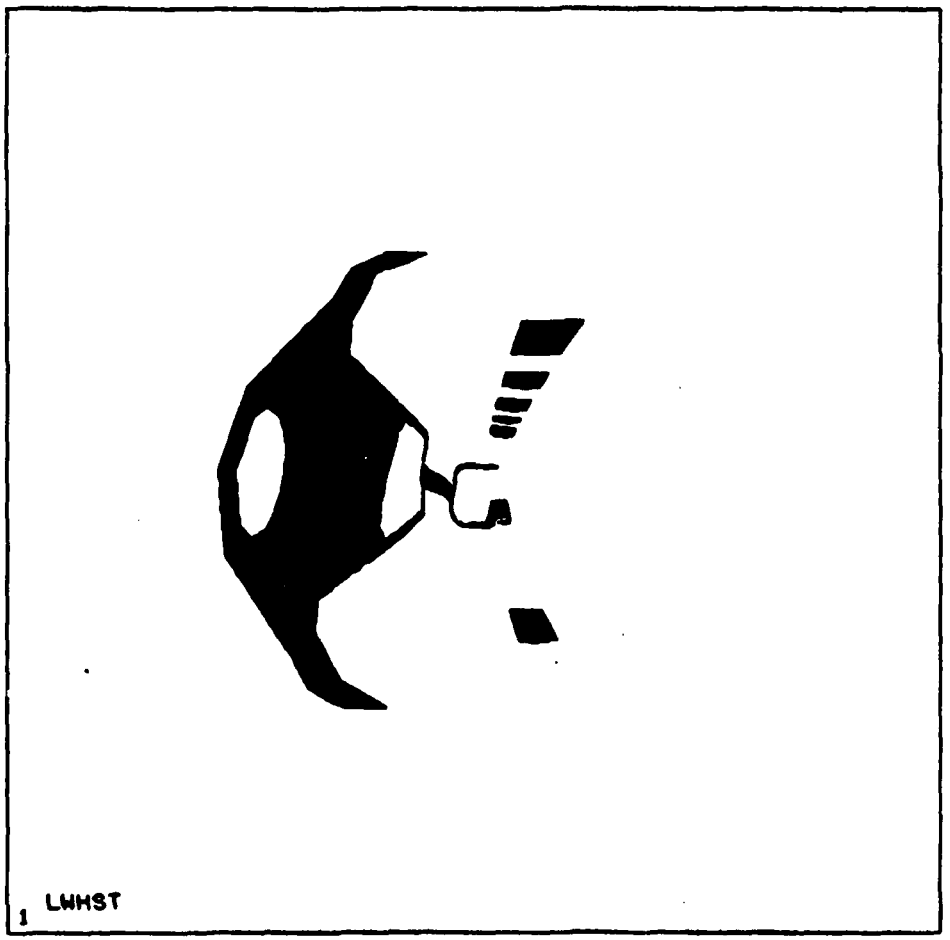
ANSYS 4.2B
MAR 3 1987
7:40:46
PLOT NO. 47
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=10085
MN=-10179
-7929
-5677
-3425
-1173
1079
3331
5583



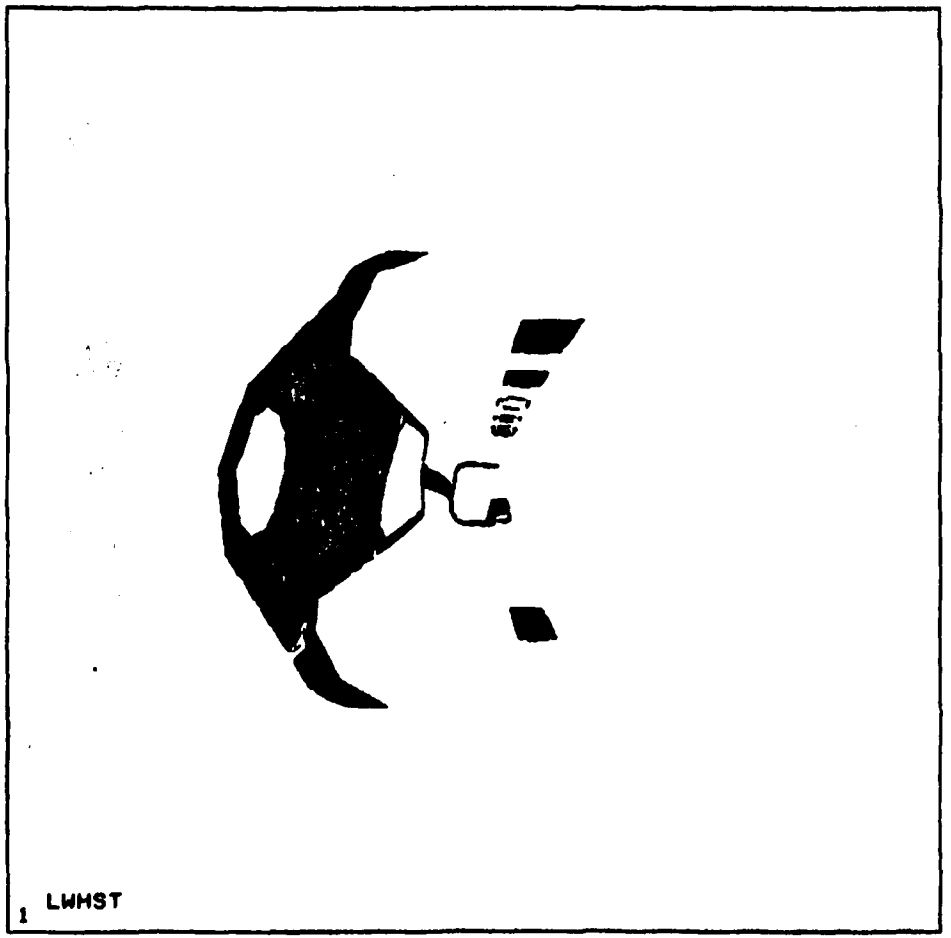
ANSYS 4.2B
MAR 3 1987
7:40:56
PLOT NO. 48
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=5116
MN=-7453
-6058
-4661
-3264
-1867
-470



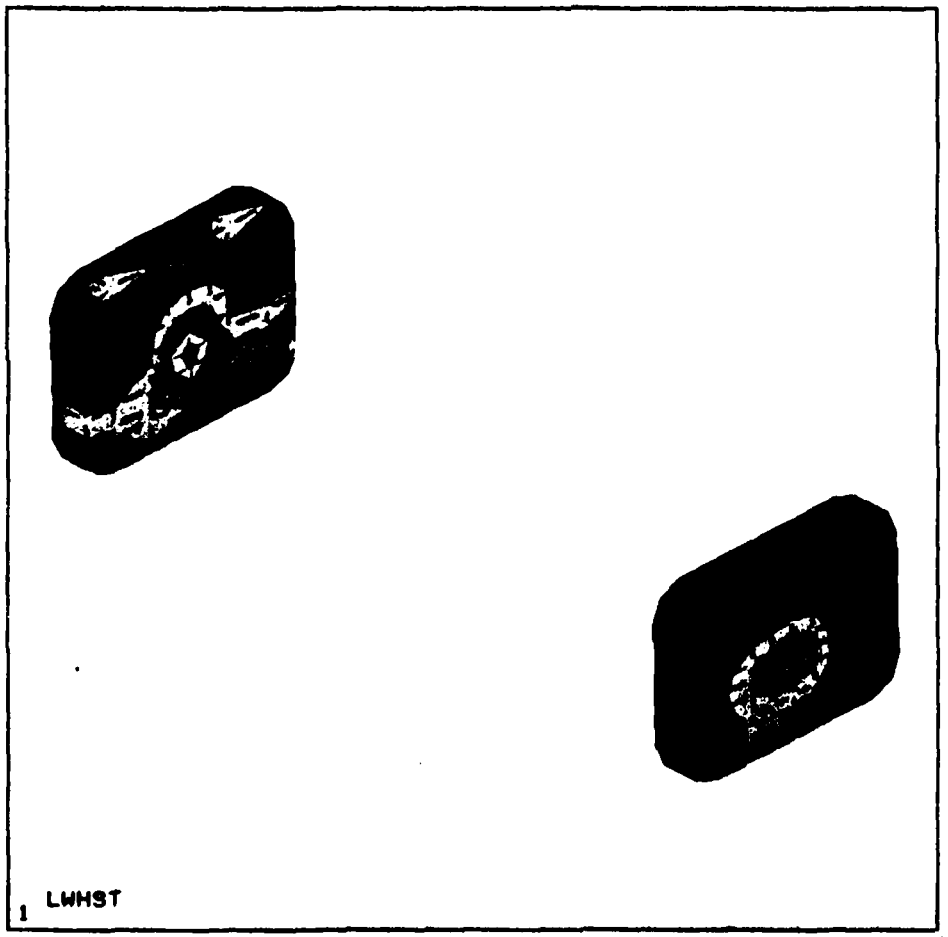
ANSYS 4.2B
MAR 3 1987
7:41:04
PLOT NO. 49
POST1 STRESS
STEP=3
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=10085
MN=-10179
-7929
-5677
-3425
-1173
1079
[illegible]
[illegible]
7835
10087



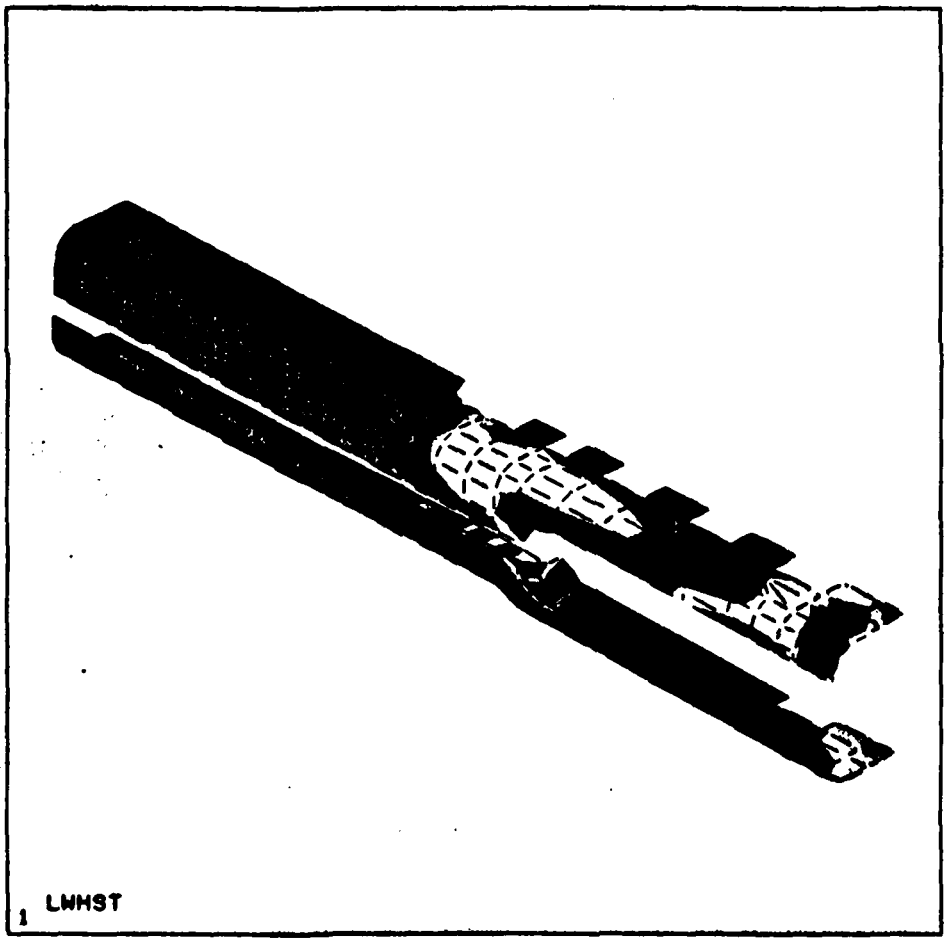
ANSYS 4.2B
MAR 3 1987
7:41:12
PLOT NO. 50
POST1 STRESS
STEP=3
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=5116
MN=-7453
-6058
-4661
-3264
-1867
-470
3721
5118



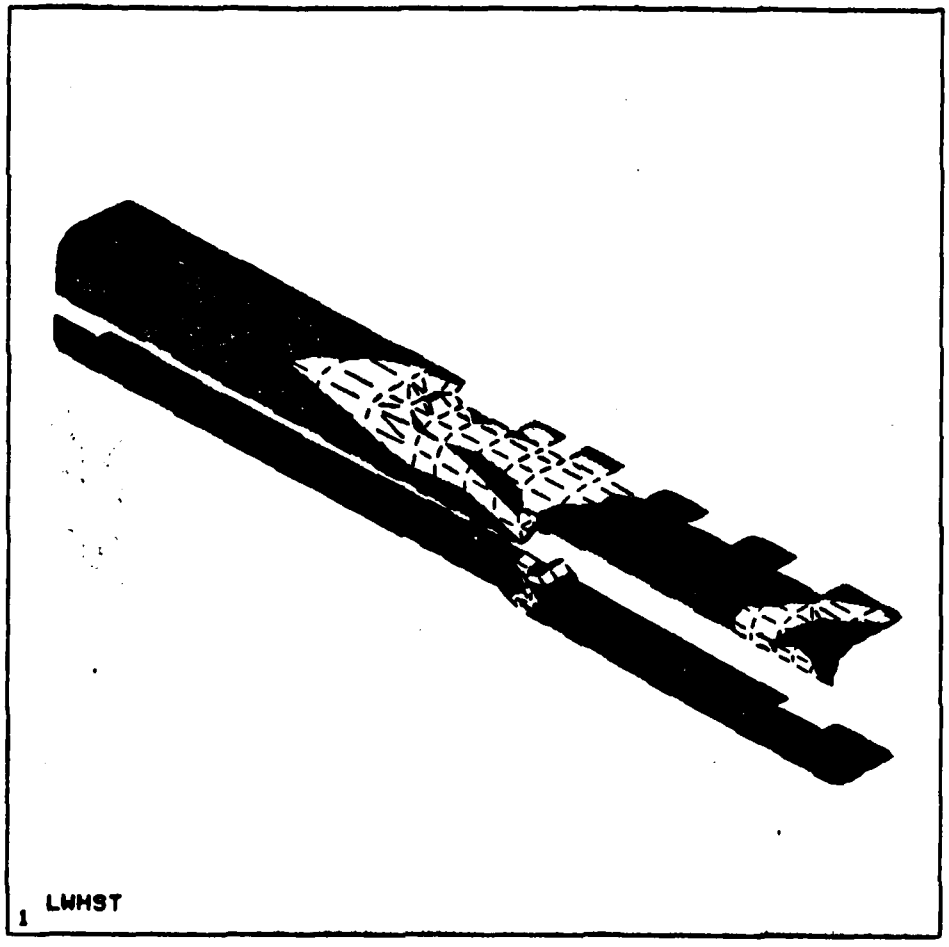
ANSYS 4.2B
MAR 3 1987
7:41:34
PLOT NO. 51
POST1 STRESS
STEP=3
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=730
MN=17.5
93.9
174
254
334
414
654
734



ANSYS 4.2B
MAR 3 1987
7:43:08
PLOT NO. 52
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=6080
MN=-19557
-16710
-13861
-11012
-8163
-5314
[illegible]
384



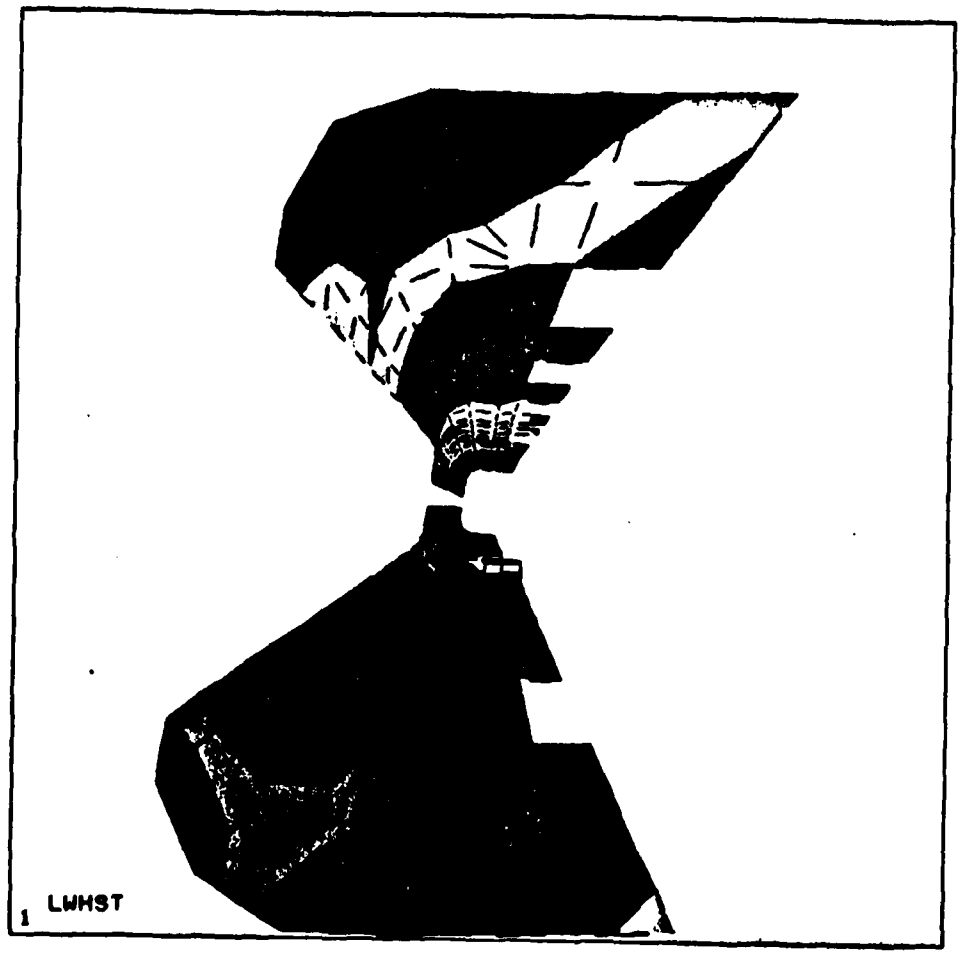
ANSYS 4.2B
MAR 3 1987
7:43:28
PLOT NO. 53
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=8.76
YF=1.51
ZF=-112
HIDDEN
MX=15483
MN=-21733
-17601
-13465
-9329
-5193
-1057

ANSYS 4.2B
MAR 3 1987
7:43:48
PLOT NO. 54
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

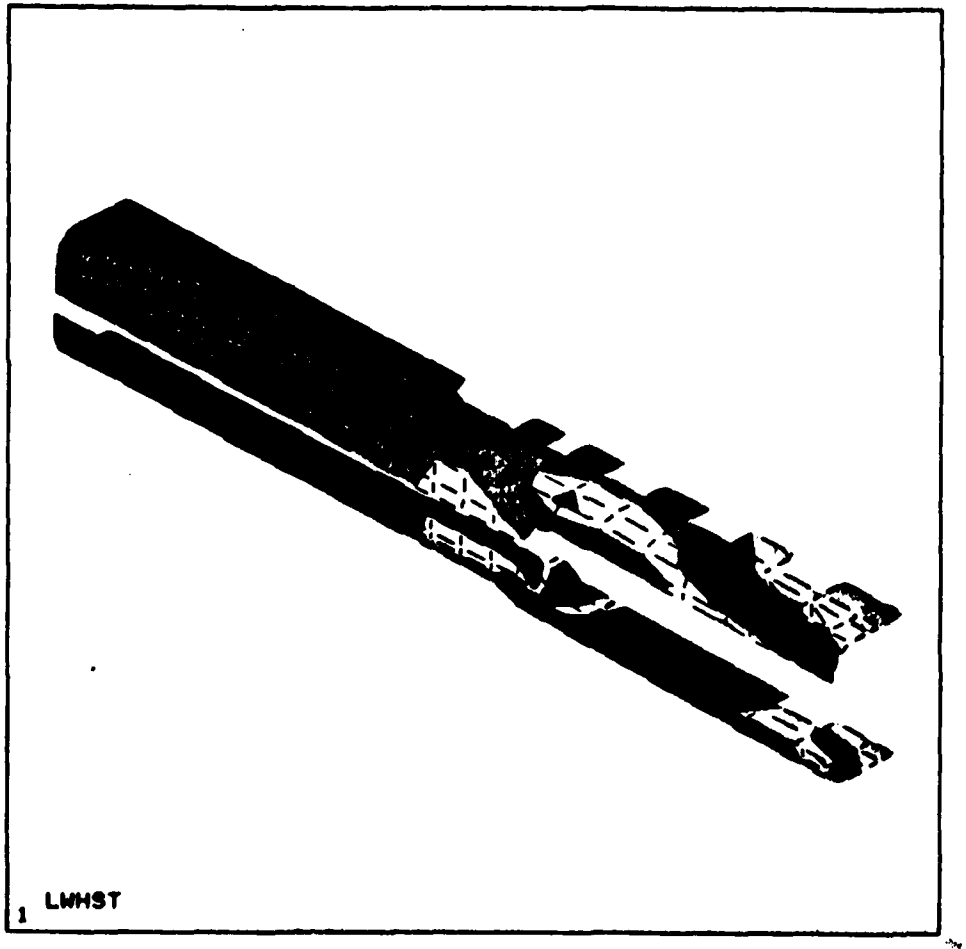
ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=6080
MN=-19557
-16710
-13861
-11012
-8163
-5314

3233
6082



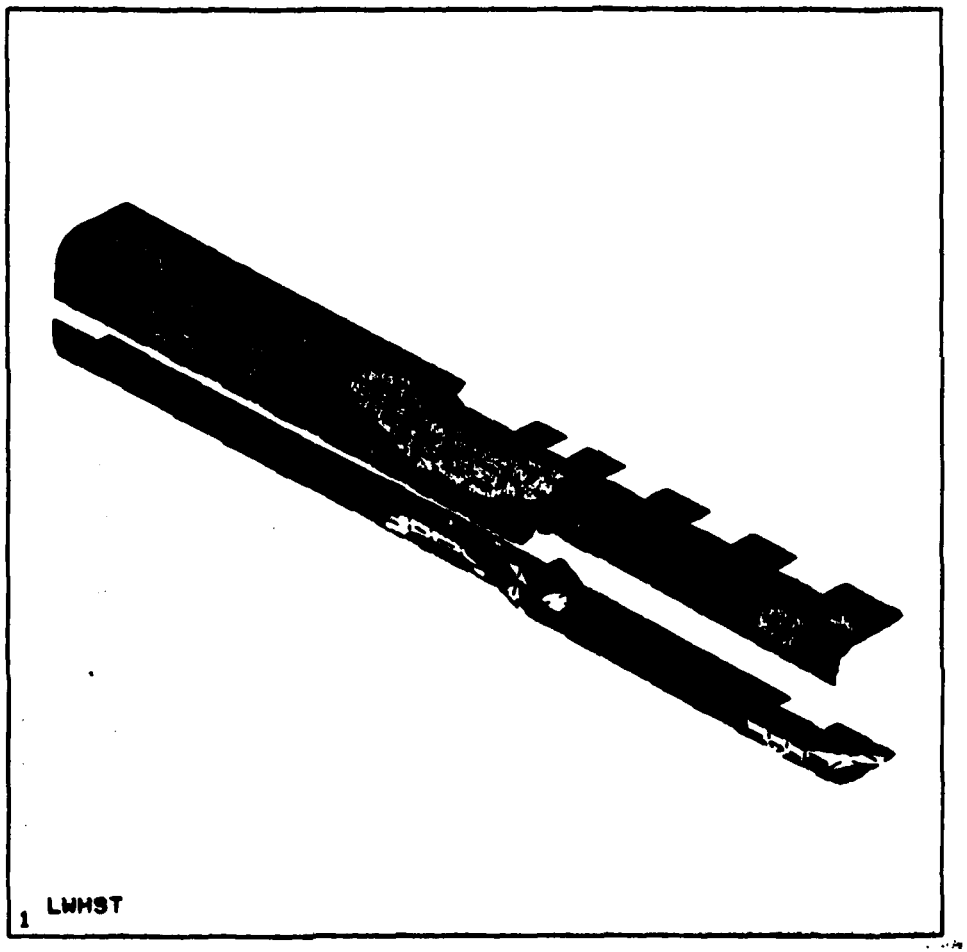
ANSYS 4.2B
MAR 3 1987
7:44:10
PLOT NO. 55
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=15483
MN=-21733
-17601
-13465
-9329
-5193
-1057
11351
15487



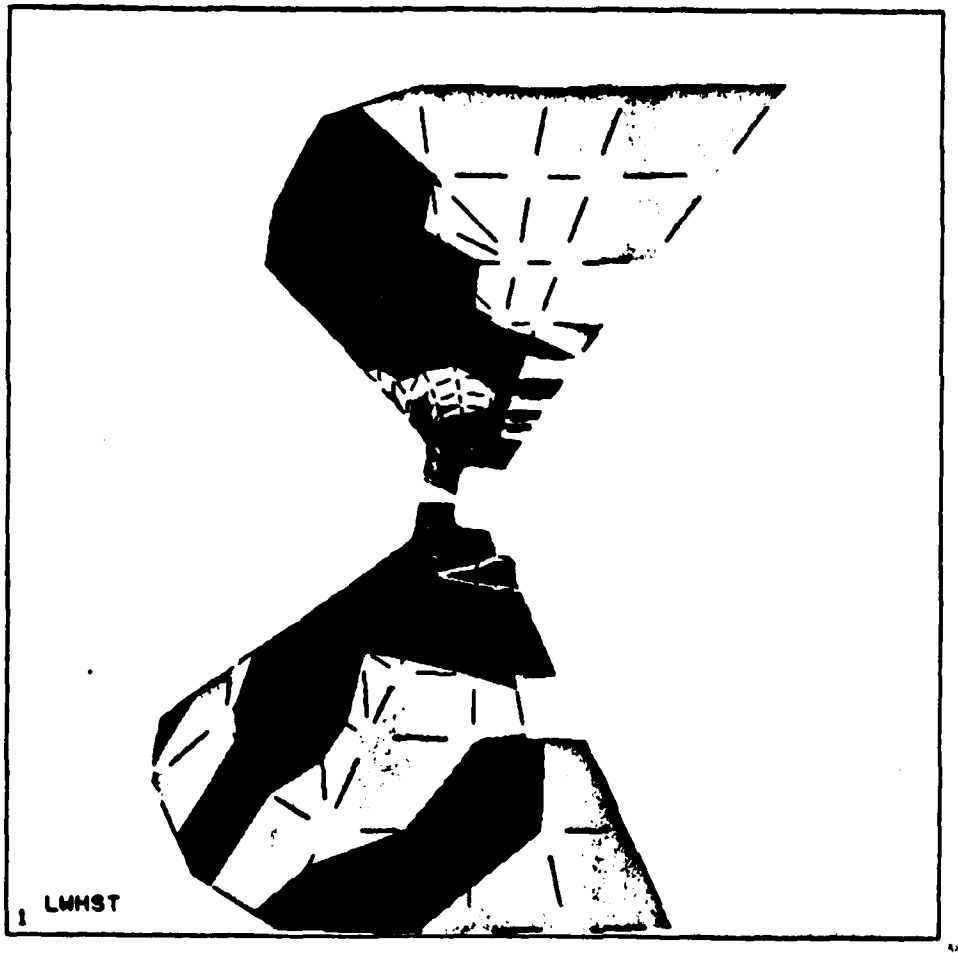
ANSYS 4.2B
MAR 3 1987
7:44:37
PLOT NO. 56
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=7395
MN=-23999
-20514
-17025
-13536
-10047
-6558



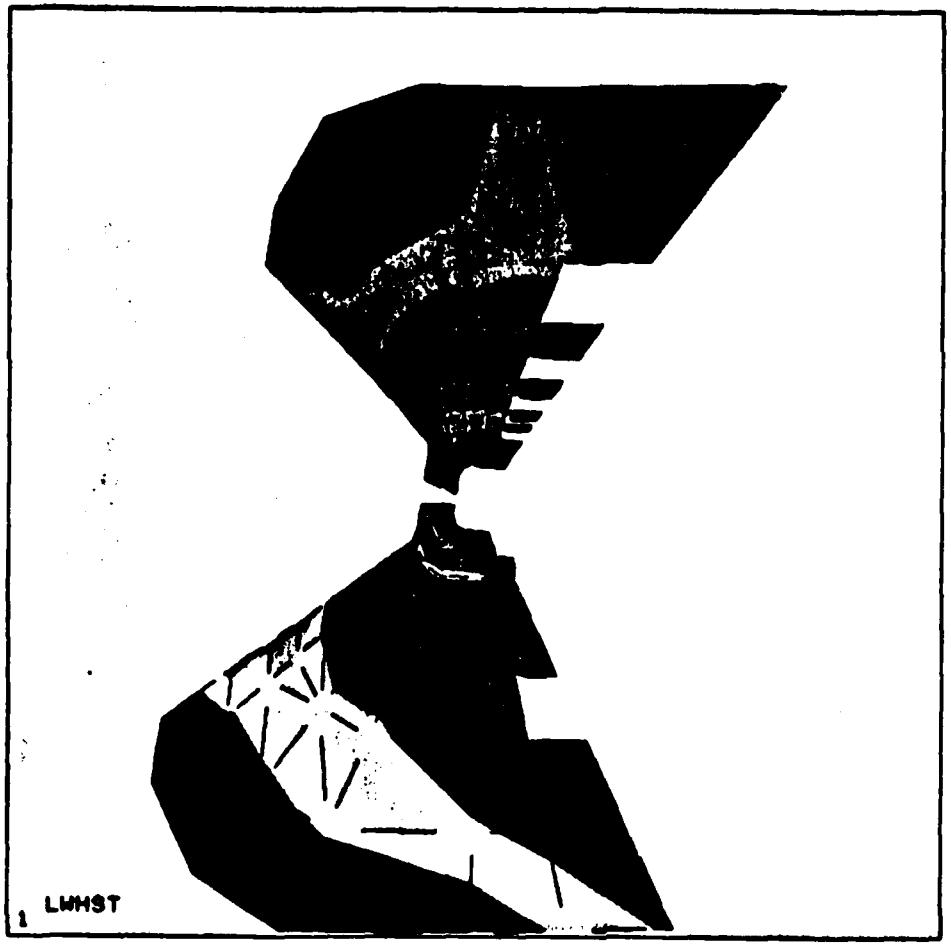
ANSYS 4.2B
MAR 3 1987
7:44:53
PLOT NO. 57
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=91.1
XF=9.76
YF=1.51
ZF=-112
HIDDEN
MX=13339
MN=-12247
-9405
-6562
-3719
-876
1967



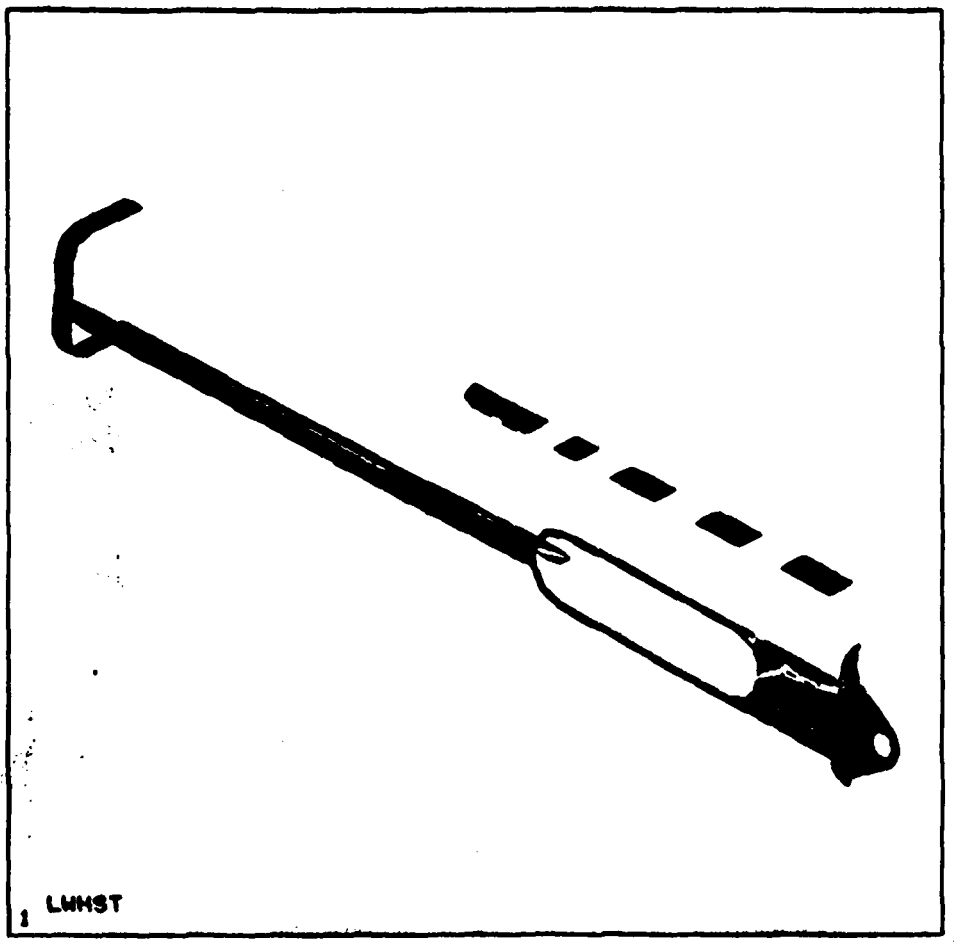
ANSYS 4.2B
MAR 3 1987
7:45:09
PLOT NO. 58
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=7395
MN=-23998
-20514
-17025
-13536
-10047
-6558
3909
7398



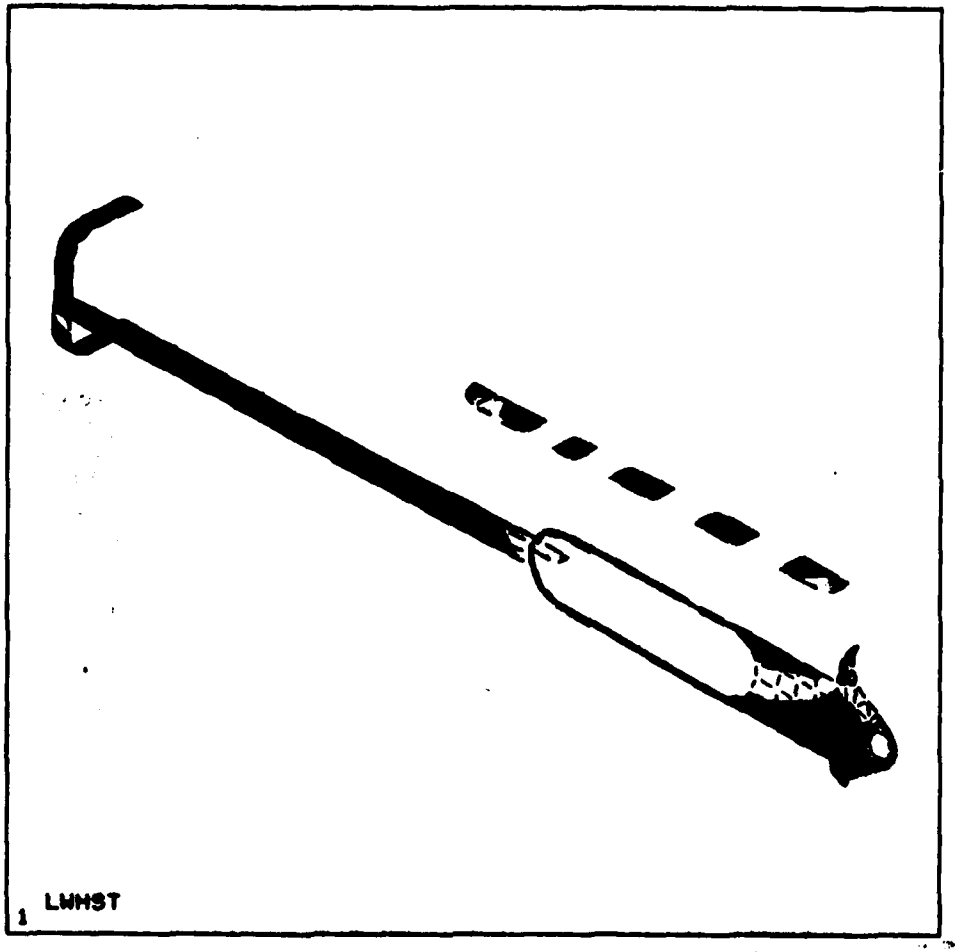
ANSYS 4.2B
MAR 3 1987
7:45:25
PLOT NO. 59
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=128
XF=9.5
ZF=-112
CONE=40
HIDDEN
MX=13339
MN=-12247
-9405
-6562
-3719
-876
1967
[illegible]
10496
13339



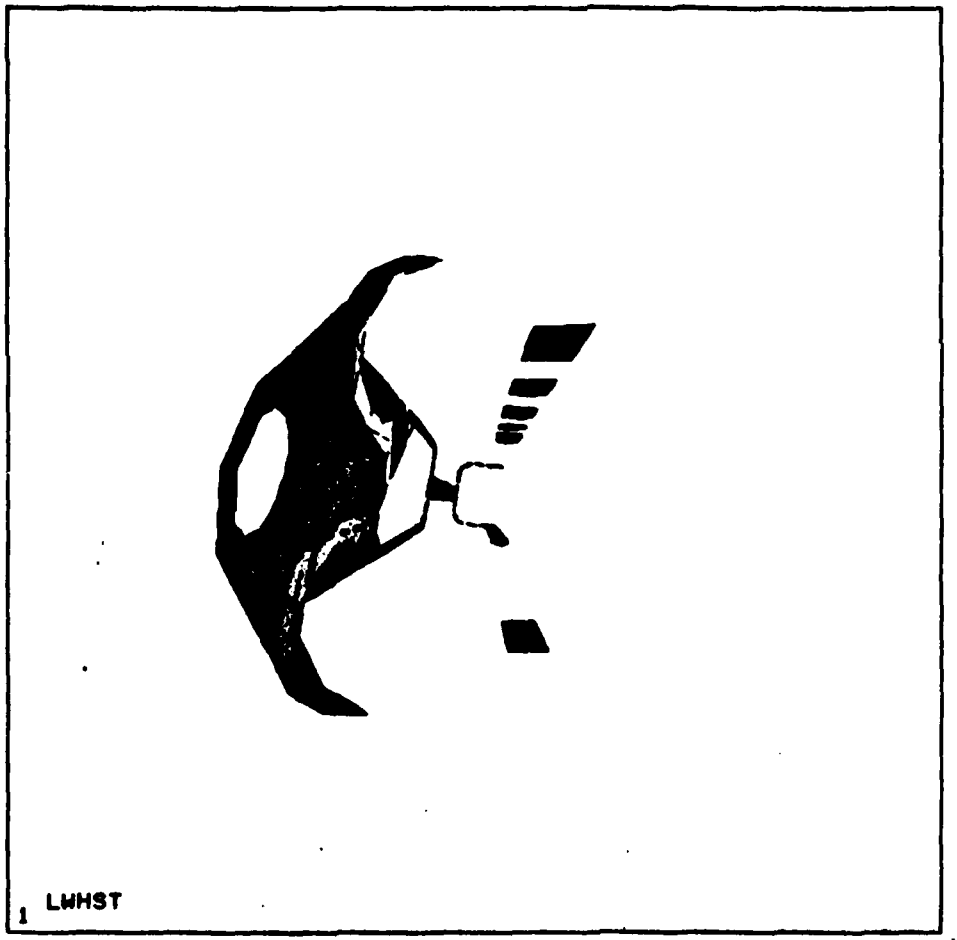
ANSYS 4.2B
MAR 3 1987
7:45:56
PLOT NO. 60
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=23654
MN=-22650
-17505
-12360
-7215
-2070
3075
8220
13365



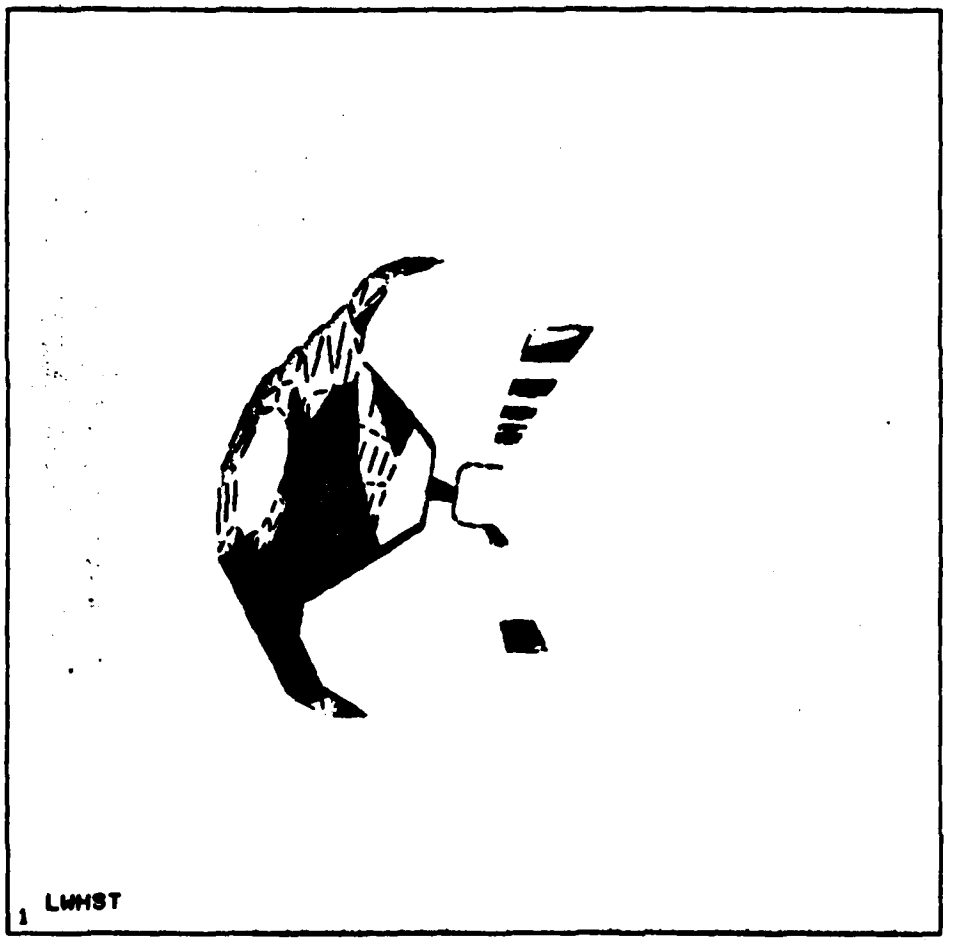
ANSYS 4.2B
MAR 3 1987
7:46:06
PLOT NO. 61
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=15218
MN=-35838
-30166
-24493
-18820
-13147
-7474
-1801
3923



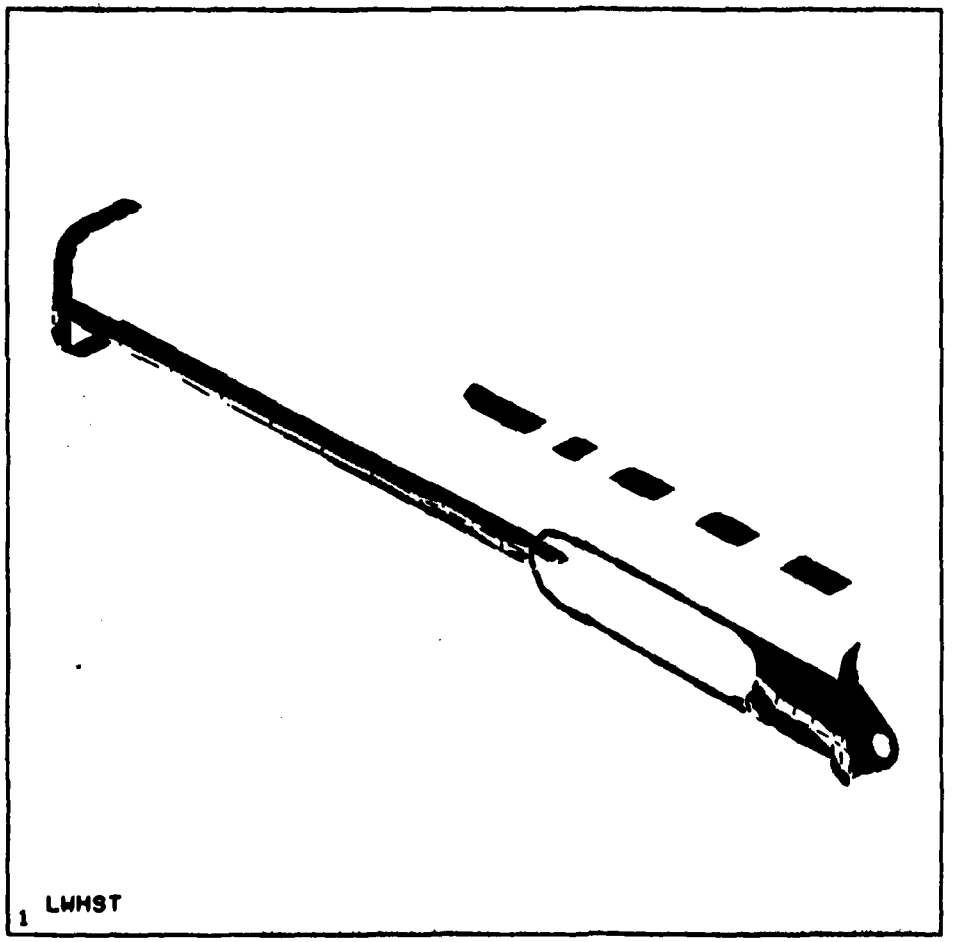
ANSYS 4.2B
MAR 3 1987
7:46:13
PLOT NO. 62
POST1 STRESS
STEP=4
ITER=1
SX
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=23654
MN=-22650
-17505
-12360
-7215
-2070
3075
18510
23655



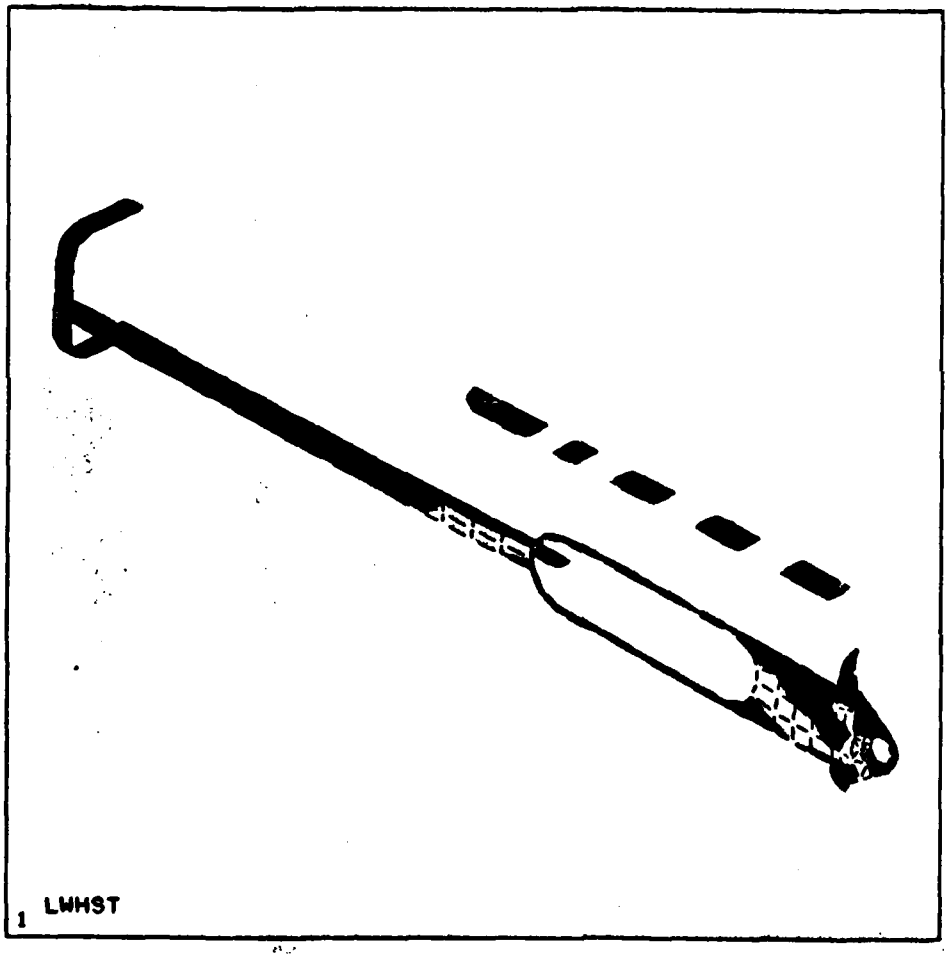
ANSYS 4.2B
MAR 3 1987
7:46:24
PLOT NO. 63
POST1 STRESS
STEP=4
ITER=1
SY
TOP
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=15218
MN=-35838
-30166
-24493
-18820
-13147
-7474
-1801
3545
9545
15218



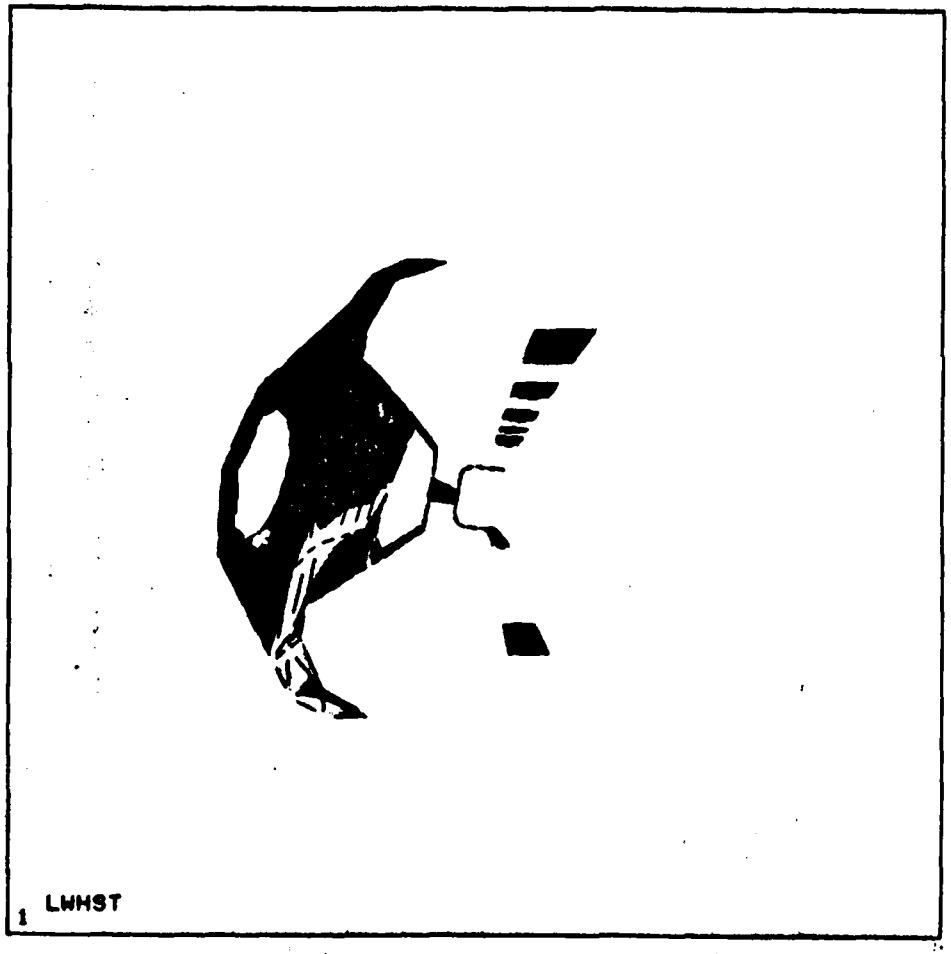
ANSYS 4.2B
MAR 3 1987
7:46:39
PLOT NO. 64
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=22780
MN=-32228
-26116
-20004
-13892
-7780
-1668
10556



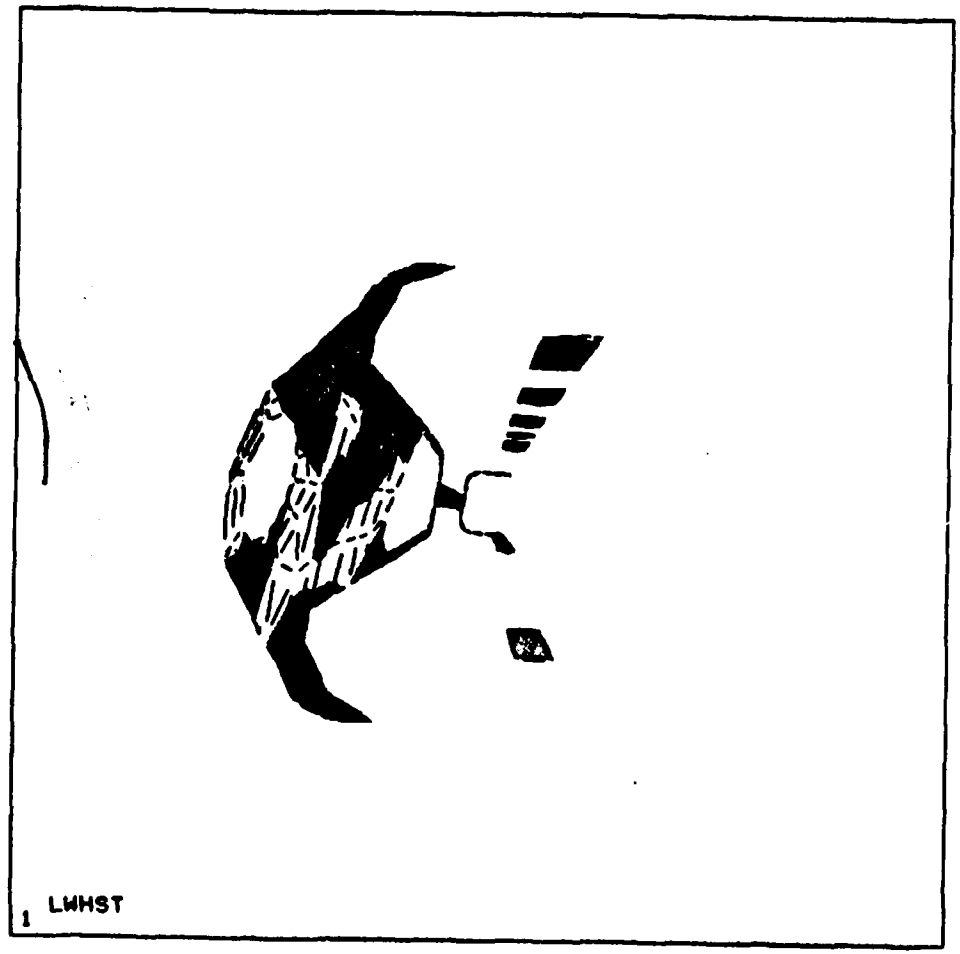
ANSYS 4.2B
MAR 3 1987
7:46:49
PLOT NO. 65
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

XV=1
YV=1
ZV=-1
DIST=92.2
XF=10.9
YF=1.46
ZF=-110
HIDDEN
MX=9792
MN=-24241
-20461
-16679
-12897
-9115
-5333
-1551
2231



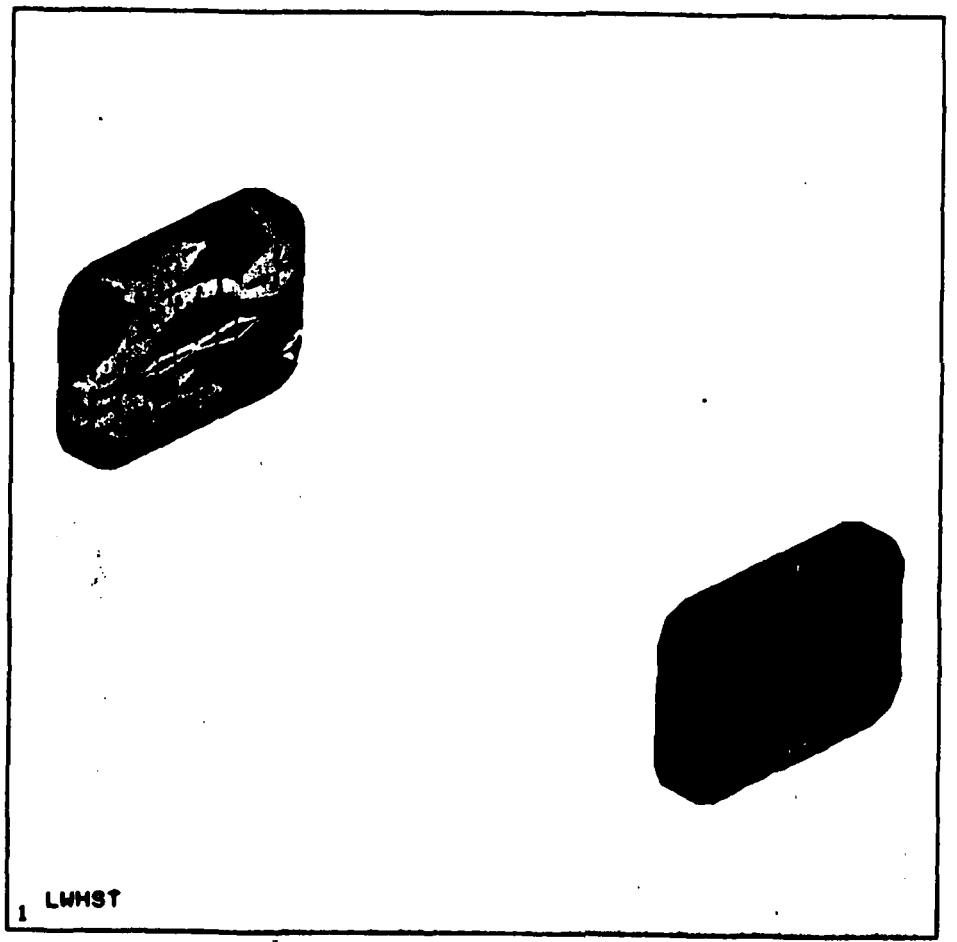
ANSYS 4.2B
MAR 3 1987
7:46:57
PLOT NO. 66
POST1 STRESS
STEP=4
ITER=1
SX
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=22780
MN=-32228
-26116
-20004
-13892
-7780
-1668
[illegible]
[illegible]
16668
22780



ANSYS 4.2B
MAR 3 1987
7:47:07
PLOT NO. 67
POST1 STRESS
STEP=4
ITER=1
SY
BOTTOM
STRESS ELEM CS

ZV=-1
DIST=139
XF=9.5
ZF=-119
CONE=40
HIDDEN
MX=9792
MN=-24241
-20461
-16679
-12897
-9115
-5333
[illegible]
[illegible]
6013
9795



ANSYS 4.2B
MAR 3 1987
7:47:29
PLOT NO. 68
POST1 STRESS
STEP=4
ITER=1
SIGE
BOTTOM

XV=1
YV=1
ZV=-1
DIST=59.9
YF=1.63
ZF=-52
HIDDEN
MX=2531
MN=12.2
292
572
852
1132
1412
[illegible]
[illegible]
2252
2532

END

10-87

DTIC